REPORT NUMBER 132

NOVEMBER 1963

EMPENNAGE STRESS ANALYSIS REPORT

XV-5A

LIFT FAN FLIGHT RESEARCH AIRCRAFT PROGR

CONTRACT NUMBER DA44-177-TC-715

GENERAL ELECTRIC

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Report No. 132

Empennage Stress Analysis Report

XV-5A Lift Fan
Flight Research Aircraft Program

November 1963

ADVANCED ENGINE AND TECHNOLOGY DEPARTMENT
GENERAL ELECTRIC COMPANY
CINCINNATI, OHIO 45215

CONTENTS

I. INTRODUCTION

This report presents the stress analysis of the Model XV-5A empennage. The structure analyzed includes the horizontal and vertical stabilizers, and the elevator and rudder. The analyses, which are intended to provide summary type information, include critical loading data; computation of internal stresses and shears, and brief detailed analyses to find margins of safety of the major components.

The empennage has been successfully proof tested to limit load. Conditions F-12 and F-13 were combined to produce the critical symmetrical condition. The critical unsymmetrical rolling moment of condition AF-6 was applied during the fuselage unsymmetrical test condition.

All loads shown in this report are ultimate values, unless otherwise stated.

MIL HDBK-5 is used for material mechanical properties and fastener allowables. Other references are given where first used.

II. HORIZONTAL STABILIZER

Description of Structure

The horizontal stabilizer is a three-spar semi-monocoque structure. The front spar ends at B. L. 29.96. The magnesium cover skin is stiffened by ribs only. The horizontal stabilizer is mounted on the tip of the vertical stabilizer by three fittings; the symmetrical pivot fittings @ the center spar and B. L. ±6 and the actuator support fitting @ the centerline of the front spar. The incidence is varied by rotation about the pivot fittings.

Critical Conditions - The following three conditions are analyzed,

F-12 - max. shear & B. M.
(sym. maneuver, $\ddot{\theta} = 3.0$, $n_{z_-} = -2.0$, mach 0.8)

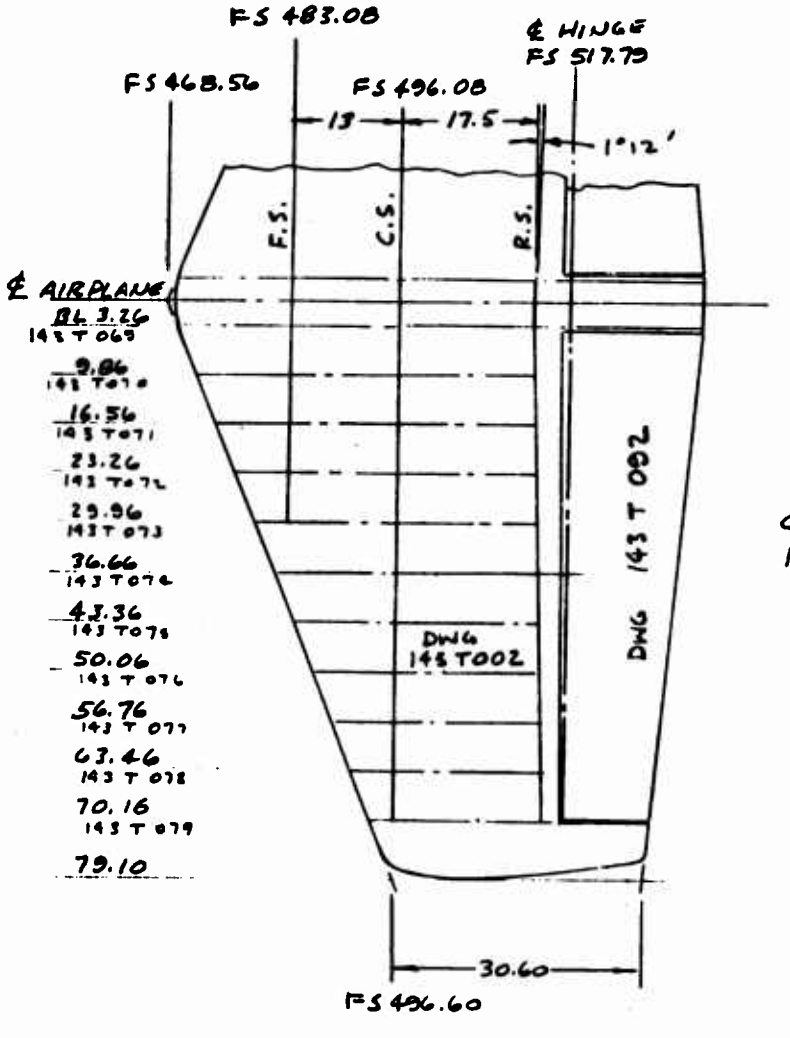
F-13 - max. torque
(sym. maneuver, $\ddot{\theta} = 0$, $n_z = +4.0$, mach 0.285)

AF-6 - max. unsymmetrical loading
(asym. flight, dyn. overswing, $n_z = 1.0$, mach 0.756)

Loading curves for conditions F-12 and F-13 are shown on pages 4 and 5.

Method of Analysis

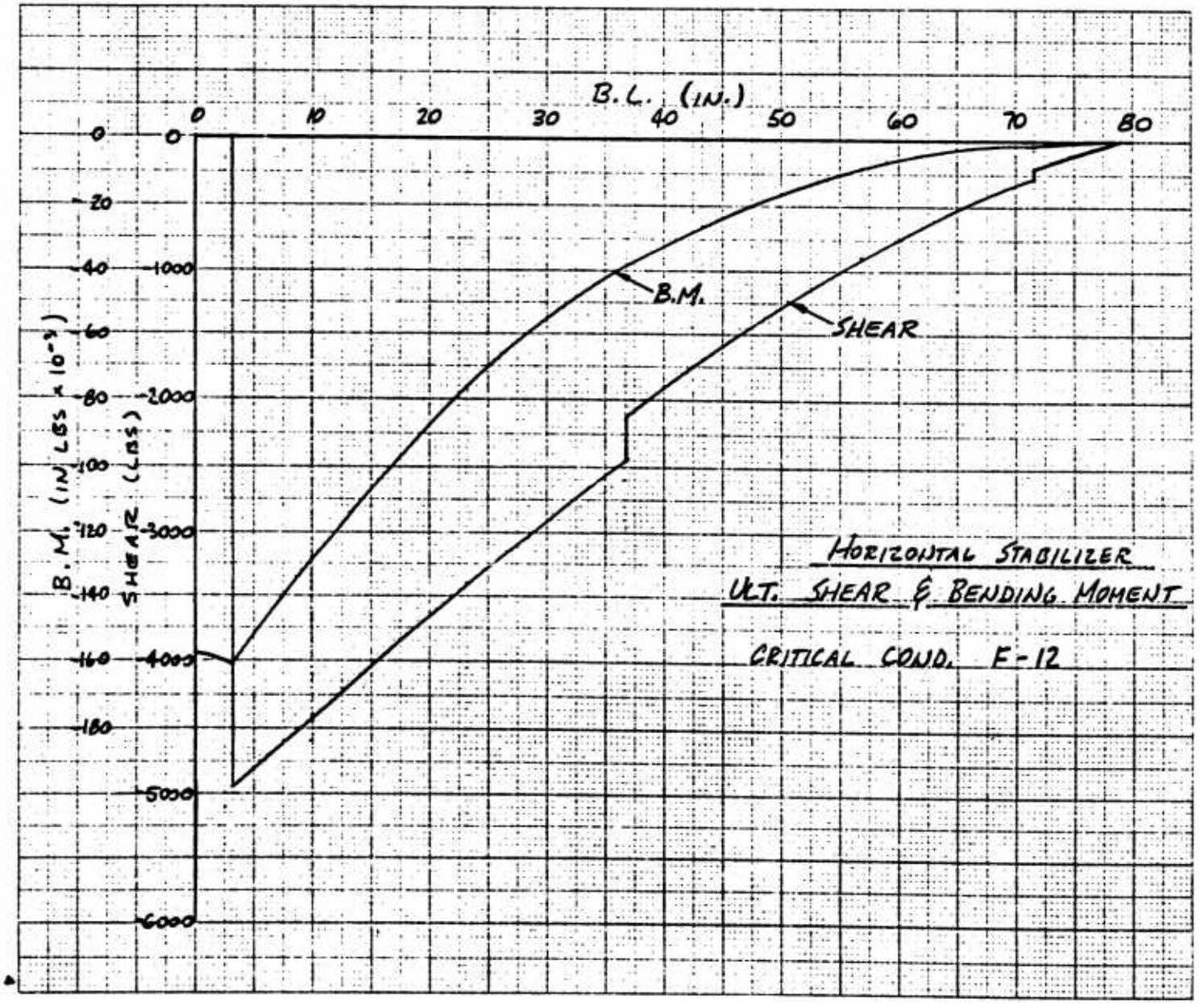
Bending stresses and shear flows are calculated at several stations from conventional engineering theory by digital computer program. This program is described in Ryan Report 62B118, "Description of Box Beam Program for IBM, Job No. 1012", 18 Nov. 1962. The format of the IBM output is described on page 23 of report 62B118.

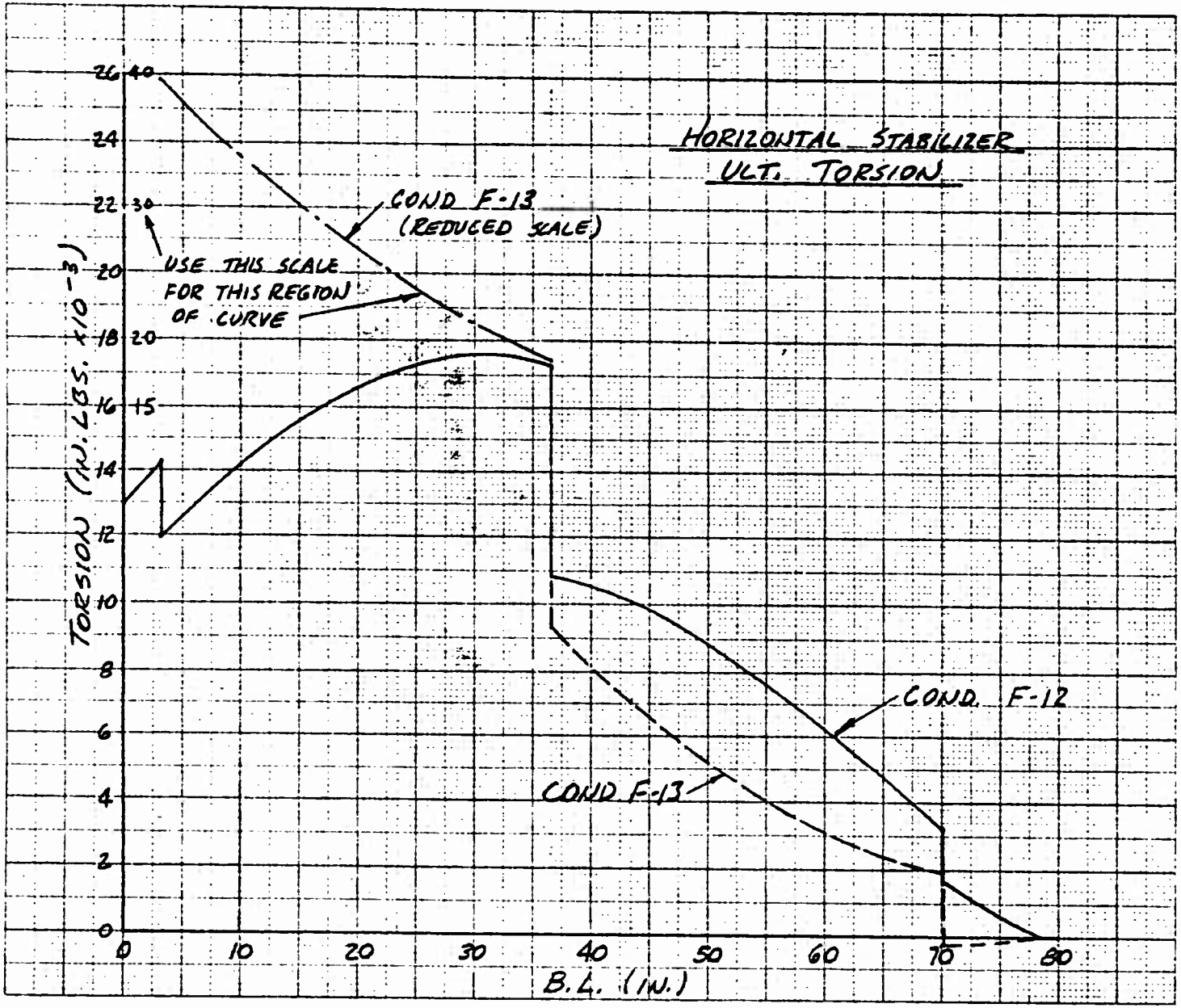


	SPAR DWGS
FS	143T064
CS	143 T 066
RS	143 T 068

HORIZONTAL STABILIZER

REF. DWG. 143T004


B.L. (IN.)
0
10
20
30
40
50
60
70
80
B.M. (IN LBS x 10⁻³)
SHEAR (LBS)
0
20
40
60
80
100
120
140
160
180
0
-1000
-2000
-3000
-4000
-5000
-6000
B.M.
SHEAR
HORIZONTAL STABILIZER
ULT. SHEAR & BENDING MOMENT
CRITICAL COND. F-12


HORIZONTAL STABILIZER
ULT. TORSION
COND F-13
(REDUCED SCALE)
USE THIS SCALE
FOR THIS REGION
OF CURVE
COND. F-12
COND F-13
TORSION (IN.LBS. X10-3)
B.L. (IN.)
40
30
20
15
26
24
22
20
18
16
14
12
10
8
6
4
2
0
0
10
20
30
40
50
60
70
80

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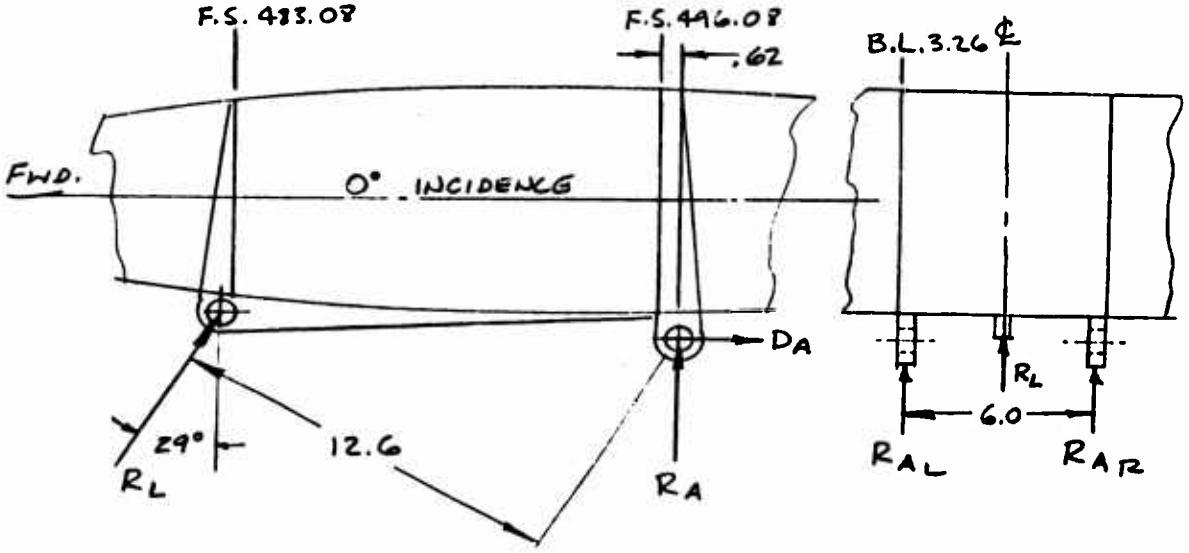
HORIZONTAL STABILIZER

ATTACHMENT LOADS



COND. F-12 – MAX SHEAR CONDITION

TOTAL SHEAR = -10653 # ULT.

T (ABOUT FS 496.08) = 25900 "# ULT.

T (ABOUT PIVOT) = 25900 - 10653 × .62 = 19290 "#

R_L = 19290/12.6 = -1530 # (TENSION IN ACT.)

R_{L_Z} = 1530 COS 29° = -1338 #

R_{L_X} = 1530 SIN 29° = -740 #

R_A = (10653 + 1338) .5 = 5996 #

D_A = 740 × .5 = 370 #

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HORIZONTAL STABILIZER

COND F-13 - MAX. TORQUE CONDITION

TOTAL SHEAR = 1280 #

T (ABOUT FS 496.08) = 89950 "#

T (ABOUT PIVOT) = 89950 + 1280 × 1.62
= 90740 "#

$R_L = \frac{90740}{12.6} = 7200$ #

NOTE: STABILIZER INCIDENCE ACTUATOR AND ATTACHMENT FITTINGS ARE DESIGNED FOR 7500# ULT. TENSILE LOAD.

COND AF-6 - MAX. UNSYMMETRICAL LOADING

TOTAL SHEAR = -6188 # @ F.S. 505.55

UNSYM. MOMENT (M_x) = 101780 "#

$T_{PIVOT} = 6188(505.55 - 496.7) = 54700$ "#

VERT. COMP. OF ACT. LOAD = $\frac{54700}{12.6} \cos 29° = 3800$ #

$R_{AL} = \frac{3800 + 6188}{2} + \frac{101780}{6} = 21970$ #

$R_{AR} = \frac{3800 + 6188}{2} - \frac{101780}{6} = -11990$ #

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HORIZONTAL STABILIZER

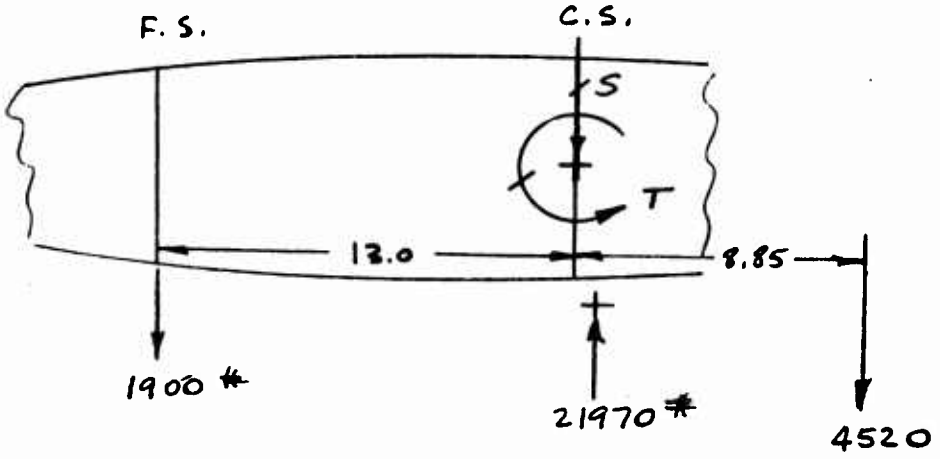
COND AF-6

NET LOADS INB'D PIVOT FTG.

3800 # COMP. OF ACTUATOR LOAD IS BEAMED EQUALLY TO BL 3.26 RIBS BY LOCAL BENDING OF FRONT SPAR (NO RIB @ ℄).

FOLLOWING DISTRIBUTION OF -6188 # SHEAR IS ASSUMED:

-4520 # LEFT SIDE
-1668 # RT. SIDE
} C.P. @ BL 55.76



$S = 21970 - 1900 - 4520 = 15550$ #

$T = 4520 \times 8.85 - 1900 \times 13 - 21970 \times .62 = 1700$ "#

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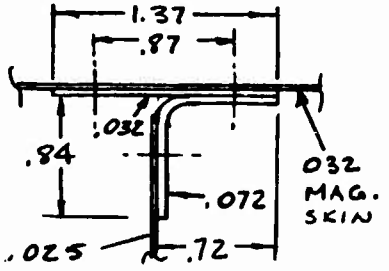
HORIZONTAL STABILIZER
(DWG. 143T002)

FRONT SPAR CAP AREAS (DWG. 143T064)

CONSTANT B.L. 0 TO B.L. 9.86



EQUIVALENT SKIN, $t_e = t_{MAG} \frac{E_{MAG}}{E_{AL}}$

$t_e = .032 \times \frac{6.5}{10.5} = .020$

ASSUME EFF. WIDTH = 15t (EACH SIDE OF RIV.)

AREAS:

ANGLE = $.072\,(.768 + .648) = .102$

STRAP = $1.37 \times .032 = .0439$

SKIN = $3 \times 15 \times .02 \times .02 = .018$

WEB = $(.31 + 15 \times .025).025 = .0171$

TOTAL = $.181$

ALLOWABLE CRIPPLING STRESS — .072 7075-T6 ANGLE
(REF. RYAN STRUCTURES MANUAL)

$\frac{b'}{t} = \frac{.804 + .684}{2 \times .072} = 10.3$ $\qquad \frac{F_{cc}}{\sqrt{F_{cy} E}} = .054$

$F_{CR} = .054 \sqrt{F_{cy} E}$

$= .054 \sqrt{10.5 \times 10^6 \times 68000}$

$= 45600$ psi

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HORIZONTAL STABILIZER

FRONT SPAR CAP AREAS

B.L. 16.56

THICKNESS OF ANGLE TAPERS FROM .071 @ BL 9.86 TO .035 @ B.L. 29.96

t @ B.L. 16.56 = .059

AREA of ANGLE = .059(.78+.66) = .085

TOTAL AREA = .164

ALLOWABLE CRIPPLING STRESS

$$\frac{b'}{t} = \frac{.81+.69}{2\times.059} = 12.7$$

$$F_{cr} = .046\sqrt{10.5\times10^6\times68000}$$

$$= 38900 \text{ psi}$$

3

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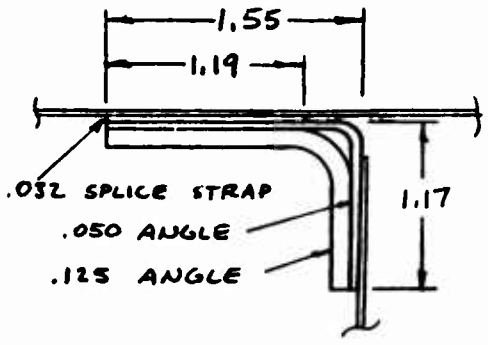
HORIZONTAL STABILIZER

CENTER SPAR CAP AREAS (DWG. 143T066)

SECTION @ B.L. 3.26



EFFECTIVE SKIN AREA ACTING WITH CENTER SPAR IS INCLUDED BY COMPUTOR.

WEB IS SPLICED AT THIS STATION, ∴ CONSIDERED NOT EFFECTIVE.

AREAS:

.050	ANGLE	= .050 (1.5 + 1.12) =	.131
.125	ANGLE	= .125 (1.375 + .995) =	.296
.032	STRAP	= 1.19 × .032 =	.038
			.465

ALLOWABLE CRIPPLING STRESS

$$\frac{b'}{t} = \frac{1.437 + 1.057}{2 \times .125} = 10 \qquad \frac{F_{cc}}{\sqrt{F_{cy} E}} = .056$$

$$F_{cr} = .056 \sqrt{10.5 \times 10^6 \times 68000}$$

$$= 47400 \text{ psi}$$

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HORIZONTAL STABILIZER

CENTER SPAR CAP AREAS

THICKNESS OF NESTED ANGLE TAPERS FROM .125 @ BL 3.26 TO .050 @ BL 35.98 (END OF PART)

SECTION @ BL 16.56

WIDTH = 1.0 DEPTH = .99 THICKNESS = .095

.050 ANGLE,	$A = .050(.95+.94) =$	.0945
NESTED ANGLE,	$A = .095(.855+.845) =$	.1613
EFF. WEB (.032)	$A = (.31+15\times.032).032 =$	.0252
		.2810

$$\frac{b'}{t} = \frac{.902+.892}{2\times.095} = 9.45$$

$$F_{cr} = .058\sqrt{10.5\times10^6\times68000}$$

$$= 49100 \text{ psi}$$

SECTION @ B.L. 29.96

WIDTH = .72 DEPTH = .78 THICKNESS = .064

.050 ANGLE,	$A = .050(.67+.73) =$	.070
NESTED ANGLE,	$A = .064(.606+.666) =$	.0815
EFF. WEB	$A = (.31+15\times.032).032 =$	.0252
		.1767

$$\frac{b'}{t} = \frac{.638+.698}{2\times.064} = 10.4$$

$$F_{cr} = .054\sqrt{10.5\times10^6\times68000}$$

$$= 45600 \text{ psi}$$

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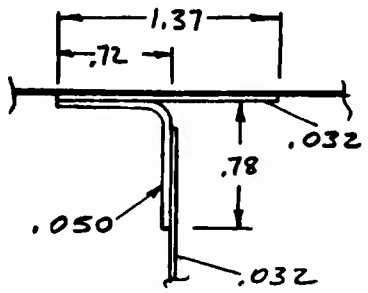
HORIZONTAL STABILIZER

CENTER SPAR CAP AREAS

B.L. 36.66 OUTB'D



AREA

.050 ANGLE,	$A = .05\,(.67 + .73)$	$= .070$
.032 STRAP,	$A = .032 \times 1.37$	$= .0439$
EFF. WEB,	$A = (1.31 + 15 \times .032).032$	$= .0252$
		$.1391$

ALLOWABLE CRIPPLING STRESS

$$\frac{b'}{t} = \frac{.695 + .755}{2 \times .050} = 14.5$$

$$F_{cr} = .042\sqrt{10.5 \times 10^6 \times 68000}$$

$$= 35600 \text{ psi}$$

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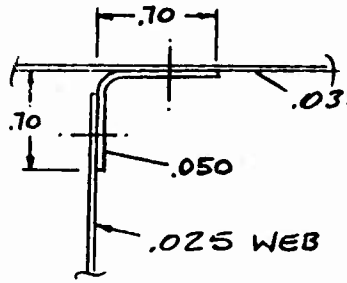
HORIZONTAL STABILIZER

REAR SPAR CAP AREAS (DWG. 143T068)



ABOVE SECTION IS CONSTANT FROM BL 0 TO TIP

AREA:

.050 ANGLE,	$A = .050 \times 2 \times .65$	$= .065$
EFF SKIN AFT RIVET,	$A = 15 \times .020 \times .020$	$= .006$
EFF WEB,	$A = (.25 + 15 \times .025) .025$	$= .016$
		$.087$

ALLOWABLE CRIPPLING STRESS

$$\frac{b'}{t} = \frac{.675}{.05} = 13.5$$

$$F_{cr} = .045 \sqrt{F_{cy} E}$$

$$= .045 \sqrt{68000 \times 10.5 \times 10^6}$$

$$= 38100 \text{ psi}$$

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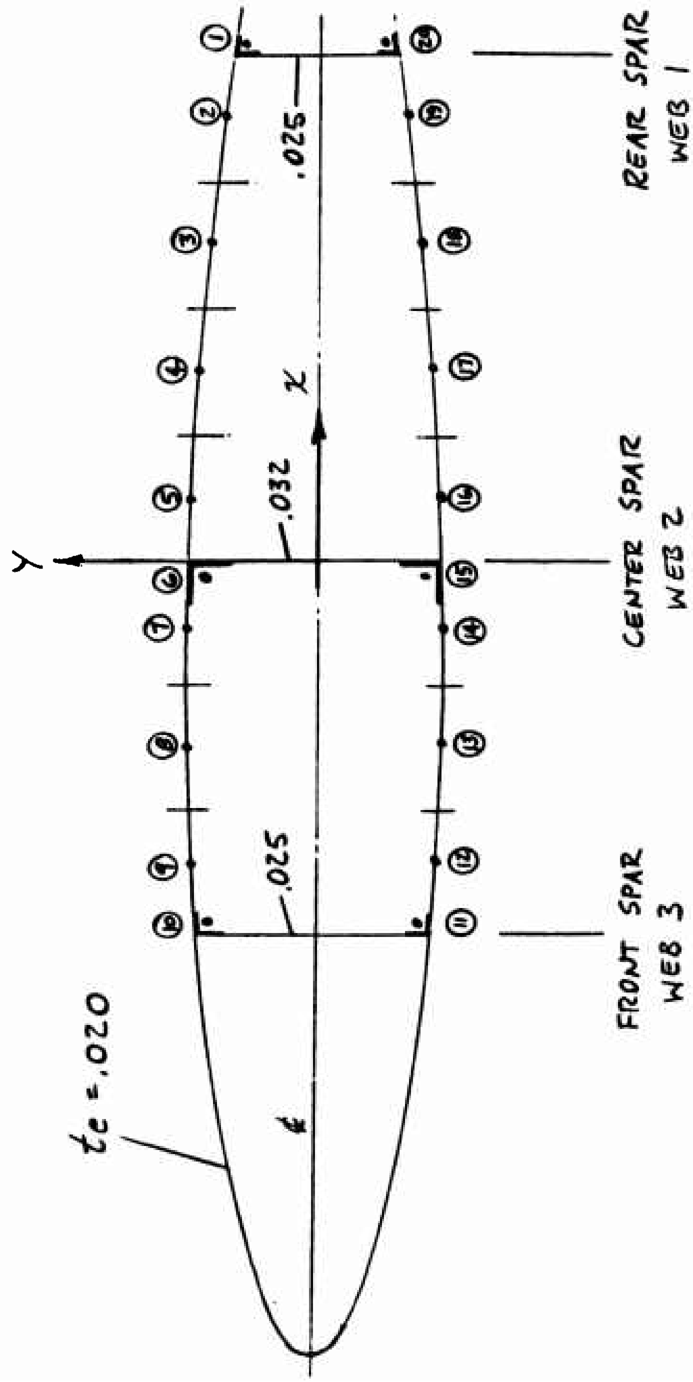
HORIZONTAL STABILIZER

SECTIONS FROM B.L. 0 TO B.L. 29.96 INB'D



.032 MAG SKIN $t_e = .032 \times \frac{6.5}{10.5} = .020$

EFFECTIVE SKIN IS DIVIDED INTO SEGMENTS. ONLY SKIN EFFECTIVE IN TENSION IS USED BY DIGITAL COMPUTER PROGRAM

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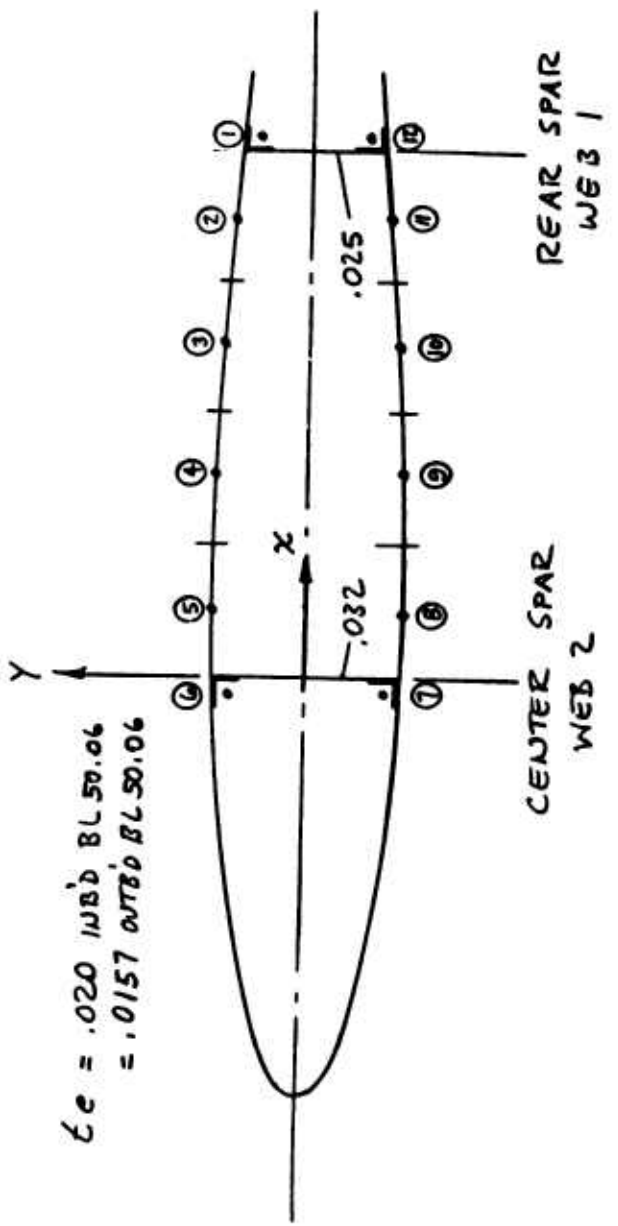
HORIZONTAL STABILIZER

SECTIONS FROM B.L. 29.96 OUTB'D



JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
43.70	0.6000	1.000	0.	0.

T(TE)	2A(LE)	DS(LE)	T(LE)
0.	120.00	28.000	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-40000.	320.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	17.50	2.53	17.50	-2.53	0.0250
2	0.	3.83	0.	-3.83	0.0320
3	-13.00	3.37	-13.00	-3.27	0.0250

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	17.75	2.28	0.09	-0.	-0.	-0.	17.50	2.53	0.020	10.50
2	15.27	2.80	0.	-0.	-0.	-0.	15.27	2.80	0.020	0.
3	10.88	3.22	0.	-0.	-0.	-0.	10.88	3.22	0.020	0.
4	6.52	3.56	0.	-0.	-0.	-0.	6.52	3.56	0.020	0.
5	2.19	3.79	0.	-0.	-0.	-0.	2.19	3.79	0.020	0.
6	-0.35	3.53	0.46	-0.	-0.	-0.	0.	3.83	0.020	10.50
7	-2.20	3.86	0.	-0.	-0.	-0.	-2.20	3.86	0.020	0.
8	-6.53	3.74	0.	-0.	-0.	-0.	-6.53	3.74	0.020	0.
9	-10.82	3.53	0.	-0.	-0.	-0.	-10.82	3.53	0.020	0.
10	-12.75	3.12	0.18	-0.	-0.	-0.	-13.00	3.37	0.020	10.50
11	-12.75	-3.12	0.18	-0.	-0.	-0.	-13.00	-3.37	0.020	10.50
12	-10.82	-3.53	0.	-0.	-0.	-0.	-10.82	-3.53	0.020	0.
13	-6.53	-3.74	0.	-0.	-0.	-0.	-6.53	-3.74	0.020	0.
14	-2.20	-3.86	0.	-0.	-0.	-0.	-2.20	-3.86	0.020	0.
15	-0.35	-3.53	0.46	-0.	-0.	-0.	0.	-3.83	0.020	10.50
16	2.19	-3.79	0.	-0.	-0.	-0.	2.19	-3.79	0.020	0.
17	6.52	-3.56	0.	-0.	-0.	-0.	6.52	-3.56	0.020	0.
18	10.88	-3.22	0.	-0.	-0.	-0.	10.88	-3.22	0.020	0.
19	15.27	-2.80	0.	-0.	-0.	-0.	15.27	-2.80	0.020	0.
20	17.75	-2.28	0.09	-0.	-0.	-0.	17.50	-2.53	0.020	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-4950.	-0.	-161000.	-0.	11900.

NO. IT.	QXP(N)	QYP(N)
3	0.00001	0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
2.18334E 01	1.67276E 02	3.86342E 00	-2.08473E-01	9.76302E-01

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
2.18331E 01	1.67273E 02	3.86397E 00	-2.08548E-01	9.76335E-01

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
6.35885E-01	1.22276E 00	3.78638E 00	5.44888E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
3.64188E-05	-0.	4.66374E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.87730E 00	5.57041E-01	0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	163.8724
CELL	1	163.8724
WEB	2	-401.1194
CELL	2	564.9917
WEB	3	-162.6290
CELL	3	-3.0886

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)		F(S)	QP(NET)	
WEB	1					163.8724	
	1	1.1231	8475.06		6581.20	140.0045	
	2	3.3282	10855.66		10855.66	116.7502	
	3	4.3916	14716.37		14716.37	77.0295	
	4	4.3547	17979.59		17979.59	28.9016	
	5	3.2632	20423.20		20423.20	-11.5656	
WEB	2					389.5538	*
	6	2.1953	21093.95		18932.50	90.4080	
	7	3.2659	21692.37		21692.37	46.7706	
	8	4.3134	21544.45		21544.45	-10.3753	
	9	3.2405	20723.29		20723.29	-51.9334	
	10	1.0929	19911.46		18017.60	-165.7176	
WEB	3					-165.7176	
	11	0.3181	-29994.06		-28185.73	-2.9781	
	12	0.	-31551.63	**	-31551.63	-2.9781	
	13	0.	-33840.31	**	-33840.31	-2.9781	
	14	0.	-35469.44	**	-35469.44	-2.9781	
	15	0.5837	-35623.60	**	-33342.42	486.4913	*
WEB	2					85.3719	
	16	0.	-35702.00	**	-35702.00	85.3719	
	17	0.	-34739.60	**	-34739.60	85.3719	
	18	0.	-32967.84	**	-32967.84	85.3719	
	19	0.	-30608.87	**	-30608.87	85.3719	
	20	0.3235	-28991.10		-27182.77	163.8724	
WEB	1					0.0000	

* VALUE IS GREATER THAN MAXIMUM
** VALUE IS LESS THAN MINIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION F-13

SX	SY	MXX	MYY	T
-4950.	-0.	-0.	-0.	39600.

NO. IT.	QXP(N)	QYP(N)
2	0.00001	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.22276E 00	1.22276E 00	3.78638E 00	5.44888E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
2.44026E-05	0.	1.55197E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.25789E 00	5.71215E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	236.3224
CELL	1	236.3224
WEB	2	-383.0221
CELL	2	619.3445
WEB	3	-137.4832
CELL	3	33.9549

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION F-13

ITEM		WP(EFF)	F(P)	F(S)	OP(NET)	
WEB	1				236.3224	
	1	1.1231	0.	0.	195.4432	
	2	3.3282	0.	0.	165.1693	
	3	4.3916	0.	0.	120.1427	
	4	4.3547	0.	0.	70.7770	
	5	3.2632	0.	0.	31.6181	
WEB	2				414.6402	*
	6	2.1953	0.	-0.	126.4700	
	7	3.2659	-0.	-0.	86.3961	
	8	4.3134	-0.	-0.	35.0124	
	9	3.2405	-0.	-0.	-1.7301	
	10	1.0929	-0.	-0.	-103.5283	
WEB	3				-103.5283	
	11	1.0929	-0.	-0.	-1.7301	
	12	3.2405	-0.	-0.	35.0124	
	13	4.3134	-0.	-0.	86.3961	
	14	3.2659	-0.	-0.	126.4700	
	15	2.1953	0.	-0.	414.6402	*
WEB	2				31.6181	
	16	3.2632	0.	0.	70.7770	
	17	4.3547	0.	0.	120.1427	
	18	4.3916	0.	0.	165.1693	
	19	3.3282	0.	0.	195.4432	
	20	1.1231	0.	0.	236.3224	
WEB	1				0.0000	

* VALUE IS GREATER THAN MAXIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION AF-6

SX	SY	MXX	MYY	T
15550.	-0.	-0.	-0.	1700.

NO. IT.	QXP(N)	QYP(N)
2	-0.00002	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.22276E 00	1.22276E 00	3.78638E 00	5.44888E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-7.66587E-05	0.	6.66248E-06

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.25789E 00	5.71215E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	-509.7087
CELL	1	-509.7087
WEB	2	1174.2493
CELL	2	-1683.9579
WEB	3	512.9666
CELL	3	73.9183

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION AF-6

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)	
WEB	1				-509.7087	**
	1	1.1231	0.	0.	-381.2903	**
	2	3.3282	0.	0.	-286.1873	
	3	4.3916	0.	0.	-144.7401	
	4	4.3547	0.	0.	10.3380	
	5	3.2632	0.	0.	133.3523	
WEB	2				-1040.8970	**
	6	2.1953	0.	-0.	-135.6351	
	7	3.2659	-0.	-0.	-9.7464	
	8	4.3134	-0.	-0.	151.6712	
	9	3.2405	-0.	-0.	267.0947	
	10	1.0929	-0.	-0.	586.8849	*
WEB	3				586.8849	*
	11	1.0929	-0.	-0.	267.0947	
	12	3.2405	-0.	-0.	151.6712	
	13	4.3134	-0.	-0.	-9.7464	
	14	3.2659	-0.	-0.	-135.6351	
	15	2.1953	0.	-0.	-1040.8970	**
WEB	2				133.3523	
	16	3.2632	0.	0.	10.3379	
	17	4.3547	0.	0.	-144.7401	
	18	4.3916	0.	0.	-286.1873	
	19	3.3282	0.	0.	-381.2903	**
	20	1.1231	0.	0.	-509.7087	**
WEB	1				-0.0000	

* VALUE IS GREATER THAN MAXIMUM
** VALUE IS LESS THAN MINIMUM

JOB NO. 1012 BOX BEAM ANALYSIS 22 AUG 63

MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

CONDITION UNIT SH

SX	SY	MXX	MYY	T
1000.	-0.	-0.	-0.	-21700.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
3.10843E 01	2.14645E 02	-2.13219E-07	3.40231E-01	-1.12572E-08

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.22276E 00	1.22276E 00	3.78638E 00	5.44888E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-4.92982E-06	0.	-8.50446E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.25789E 00	5.71215E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	-73.0209
CELL	1	-73.0209
WEB	2	80.5269
CELL	2	-153.5478
WEB	3	18.9661
CELL	3	-26.4790

CONDITION FOR UNIT 1000 # LOAD APPLIED AT HINGE FITTING.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 3.26

22 AUG 63

CONDITION UNIT SH

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				-73.0209
	1	1.1231	0.	0.	-64.7625
	2	3.3282	0.	0.	-58.6466
	3	4.3916	0.	0.	-49.5503
	4	4.3547	0.	0.	-39.5774
	5	3.2632	0.	0.	-31.6665
WEB	2				-112.1934
	6	2.1953	0.	-0.	-53.9772
	7	3.2659	-0.	-0.	-45.8815
	8	4.3134	-0.	-0.	-35.5009
	9	3.2405	-0.	-0.	-28.0782
	10	1.0929	-0.	-0.	-7.5129
WEB	3				-7.5129
	11	1.0929	-0.	-0.	-28.0782
	12	3.2405	-0.	-0.	-35.5009
	13	4.3134	-0.	-0.	-45.8815
	14	3.2659	-0.	-0.	-53.9772
	15	2.1953	0.	-0.	-112.1934
WEB	2				-31.6665
	16	3.2632	0.	0.	-39.5774
	17	4.3547	0.	0.	-49.5503
	18	4.3916	0.	0.	-58.6466
	19	3.3282	0.	0.	-64.7625
	20	1.1231	0.	0.	-73.0209
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900
C	**X0/C**	**R(WEB)**	**2A(TE)**	**DS(TE)**
39.60	0.5470	1.000	0.	0.
T(TE)	**2A(LE)**	**DS(LE)**	**T(LE)**	
0.	65.00	18.800	0.0200	
FP(MAX)	**FP(MIN)**	**FS(MIN)**	**QP(MAX)**	
45000.	-30000.	-40000.	320.	

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	17.90	2.30	17.90	-2.30	0.0250
2	0.	3.46	0.	-3.46	0.0320
3	-13.00	2.63	-13.00	-2.63	0.0250

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	18.15	2.05	0.09	-0.	-0.	-0.	17.90	2.30	0.020	10.50
2	15.70	2.54	0.	-0.	-0.	-0.	15.70	2.54	0.020	0.
3	11.22	2.98	0.	-0.	-0.	-0.	11.22	2.98	0.020	0.
4	6.70	3.29	0.	-0.	-0.	-0.	6.70	3.29	0.020	0.
5	2.22	3.47	0.	-0.	-0.	-0.	2.22	3.47	0.020	0.
6	-0.25	3.21	0.28	-0.	-0.	-0.	0.	3.46	0.020	10.50
7	-2.18	3.43	0.	-0.	-0.	-0.	-2.18	3.43	0.020	0.
8	-6.58	3.23	0.	-0.	-0.	-0.	-6.58	3.23	0.020	0.
9	10.83	2.89	0.	-0.	-0.	-0.	-10.83	2.89	0.020	0.
10	-12.75	2.38	0.16	-0.	-0.	-0.	-13.00	2.63	0.020	10.50
11	-12.75	-2.38	0.16	-0.	-0.	-0.	-13.00	-2.63	0.020	10.50
12	10.83	-2.89	0.	-0.	-0.	-0.	-10.83	-2.89	0.020	0.
13	-6.58	-3.23	0.	-0.	-0.	-0.	-6.58	-3.23	0.020	0.
14	-2.18	-3.43	0.	-0.	-0.	-0.	-2.18	-3.43	0.020	0.
15	-0.25	-3.21	0.28	-0.	-0.	-0.	0.	-3.46	0.020	10.50
16	2.22	-3.47	0.	-0.	-0.	-0.	2.22	-3.47	0.020	0.
17	6.70	-3.29	0.	-0.	-0.	-0.	6.70	-3.29	0.020	0.
18	11.22	-2.98	0.	-0.	-0.	-0.	11.22	-2.98	0.020	0.
19	15.70	-2.54	0.	-0.	-0.	-0.	15.70	-2.54	0.020	0.
20	18.15	-2.05	0.09	-0.	-0.	-0.	17.90	-2.30	0.020	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-3980.	-0.	-101000.	-0.	15900.

NO. IT.	QXP(N)	QYP(N)
3	0.00001	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
1.26516E 01	1.66809E 02	3.60062E 00	2.24230E-01	1.08724E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
1.26513E 01	1.66805E 02	3.60112E 00	2.24142E-01	1.08730E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
6.44157E-01	1.23931E 00	3.14725E 00	4.48400E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
2.29099E-05	0.	8.32638E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.09921E 00	5.19242E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	177.2504
CELL	1	177.2504
WEB	2	-345.4932
CELL	2	522.7436
WEB	3	-148.0167
CELL	3	-4.4975

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)		F(S)	QP(NET)	
WEB	1					177.2504	
	1	1.1065	6676.05		4624.50	155.0706	
	2	3.3573	8985.43		8985.43	129.8029	
	3	4.5161	13296.75		13296.75	82.4553	
	4	4.5071	16570.75		16570.75	23.6191	
	5	3.3518	18793.55		18793.55	-25.4628	
WEB	2					320.0304	*
	6	2.2001	19098.21		17133.38	97.1977	
	7	3.2924	19235.28		19235.28	47.4412	
	8	4.3341	18391.76		18391.76	-15.4200	
	9	3.2245	16397.65		12641.43	-57.8506	
	10	1.0928	14685.44		12633.90	-152.5143	
WEB	3					-152.5143	
	11	0.3318	-27566.86		-25602.02	20.1980	
	12	0.	-30031.69	**	-33787.90	20.1980	
	13	0.	-33499.85	**	-33499.85	20.1980	
	14	0.	-35869.44	**	-35869.44	20.1980	
	15	0.5768	-36488.47	**	-34436.93	418.1069	*
WEB	2					72.6136	
	16	0.	-36953.78	**	-36953.78	72.6136	
	17	0.	-36284.79	**	-36284.79	72.6136	
	18	0.	-34578.49	**	-34578.49	72.6136	
	19	0.	-31820.98	**	-31820.98	72.6136	
	20	0.3166	-30274.64	**	-28309.80	177.2504	
WEB	1					0.0000	

* VALUE IS GREATER THAN MAXIMUM
** VALUE IS LESS THAN MINIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

CONDITION F-13

SX	SY	MXX	MYY	T
-3980.	-0.	-0.	-0.	29000.

NO. IT.	QXP(N)	QYP(N)
2	0.00001	0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
2.05239E 01	2.15406E 02	-2.19346E-07	8.14388E-01	-2.22388E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
2.05239E 01	2.15406E 02	-2.19346E-07	8.14388E-01	-2.22388E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.23931E 00	1.23931E 00	3.14725E 00	4.48400E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
5.78968E-06	-0.	1.51865E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
-2.77787E-01	5.39985E-01	0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	225.1457
CELL	1	225.1457
WEB	2	-325.4054
CELL	2	550.5511
WEB	3	-123.6431
CELL	3	14.8414

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 16.56

22 AUG 63

CONDITION F-13

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				225.1457
	1	1.1065	0.	0.	180.4320
	2	3.3573	0.	0.	146.6042
	3	4.5161	0.	0.	94.3983
	4	4.5071	0.	0.	36.8989
	5	3.3518	0.	0.	-8.0235
WEB	2				317.3819
	6	2.2001	0.	-0.	112.9392
	7	3.2924	-0.	-0.	69.3890
	8	4.3341	-0.	-0.	15.0583
	9	3.2245	-0.	0.	-21.6889
	10	1.0928	-0.	-0.	-108.8018
WEB	3				-108.8018
	11	1.0928	-0.	-0.	-21.6889
	12	3.2245	-0.	0.	15.0583
	13	4.3341	-0.	-0.	69.3890
	14	3.2924	-0.	-0.	112.9392
	15	2.2001	0.	-0.	317.3819
WEB	2				-8.0235
	16	3.3518	0.	0.	36.8989
	17	4.5071	0.	0.	94.3983
	18	4.5161	0.	0.	146.6042
	19	3.3573	0.	0.	180.4320
	20	1.1065	0.	0.	225.1457
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900
C	**XO/C**	**R(WEB)**	**2A(TE)**	**DS(TE)**
35.05	0.4810	1.000	-0.	-0.
T(TE)	**2A(LE)**	**DS(LE)**	**T(LE)**	
-0.	18.00	8.600	0.0200	
FP(MAX)	**FP(MIN)**	**FS(MIN)**	**QP(MAX)**	
45000.	-30000.	-40000.	320.	

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.18	2.12	18.18	-2.12	0.0250
2	0.	3.08	0.	-3.08	0.0320
3	-13.00	1.75	-13.00	-1.75	0.0250

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	18.43	1.87	0.09	-0.	-0.	-0.	18.18	2.12	0.020	10.50
2	15.85	2.38	0.	-0.	-0.	-0.	15.85	2.38	0.020	0.
3	11.30	2.77	0.	-0.	-0.	-0.	11.30	2.77	0.020	0.
4	6.78	3.04	0.	-0.	-0.	-0.	6.78	3.04	0.020	0.
5	2.30	3.12	0.	-0.	-0.	-0.	2.30	3.12	0.020	0.
6	-0.25	2.83	0.18	-0.	-0.	-0.	0.	3.08	0.020	10.50
7	-2.18	2.98	0.	-0.	-0.	-0.	-2.18	2.98	0.020	0.
8	-6.50	2.68	0.	-0.	-0.	-0.	-6.50	2.68	0.020	0.
9	-10.85	2.11	0.	-0.	-0.	-0.	-10.85	2.11	0.020	0.
10	-13.00	1.75	0.	-0.	-0.	-0.	-13.00	1.75	0.020	0.
11	-13.00	-1.75	0.	-0.	-0.	-0.	-13.00	-1.75	0.020	0.
12	-10.85	-2.11	0.	-0.	-0.	-0.	-10.85	-2.11	0.020	0.
13	-6.50	-2.68	0.	-0.	-0.	-0.	-6.50	-2.68	0.020	0.
14	-2.18	-2.98	0.	-0.	-0.	-0.	-2.18	-2.98	0.020	0.
15	-0.25	-2.83	0.18	-0.	-0.	-0.	0.	-3.08	0.020	10.50
16	2.30	-3.12	0.	-0.	-0.	-0.	2.30	-3.12	0.020	0.
17	6.78	-3.04	0.	-0.	-0.	-0.	6.78	-3.04	0.020	0.
18	11.30	-2.77	0.	-0.	-0.	-0.	11.30	-2.77	0.020	0.
19	15.85	-2.38	0.	-0.	-0.	-0.	15.85	-2.38	0.020	0.
20	18.43	-1.87	0.09	-0.	-0.	-0.	18.18	-2.12	0.020	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-2910.	-0.	-55500.	-0.	17600.

NO. IT.	QXP(N)	QYP(N)
3	0.00001	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
5.93590E 00	9.00368E 01	-2.18427E 00	4.45439E 00	1.40813E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
5.93521E 00	9.00332E 01	-2.18389E 00	4.45427E 00	1.40828E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
6.21130E-01	1.25200E 00	2.34202E 00	3.55666E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-6.45778E-05	0.	1.29122E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
3.02484E 00	5.67301E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	193.0577
CELL	1	193.0577
WEB	2	-311.5655
CELL	2	504.6231
WEB	3	-35.4895
CELL	3	-1.0174

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)		F(S)		QP(NET)	
WEB	1						193.0577	
	1	1.1722	9856.58		7555.00		145.8883	
	2	3.4556	11776.48		11776.48		101.8863	
	3	4.5474	14414.87		14414.87		33.1686	
	4	4.5044	15927.90		15927.90		-42.0594	
	5	3.3905	15657.40		15657.40		-98.0646	
WEB	2						213.5009	
	6	2.2413	14753.61		12337.59		64.4829	
	7	3.2563	13311.16		13311.16		20.5101	
	8	4.3588	9491.91		9491.91		-22.8001	
	9	3.2836	3118.29		3118.29		-36.5069	
	10	0.	-770.44		-770.44		-36.5069	
WEB	3						-36.5069	
	11	0.	-33793.61	**	-33793.61		-36.5069	
	12	0.	-36698.22	**	-36698.22		-36.5069	
	13	0.	-41080.72	**	-41080.72	**	-36.5069	
	14	0.	-42922.58	**	-42922.58	**	-36.5069	
	15	0.5291	-43367.18	**	-41065.60	**	368.0192	*
WEB	2						56.4537	
	16	0.	-43218.20	**	-43218.20	**	56.4537	
	17	0.	-41438.07	**	-41438.07	**	56.4537	
	18	0.	-37856.10	**	-37856.10		56.4537	
	19	0.	-33135.04	**	-33135.04		56.4537	
	20	0.3173	-30148.63	**	-27732.62		193.0577	
WEB	1						0.0000	

* VALUE IS GREATER THAN MAXIMUM
** VALUE IS LESS THAN MINIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

CONDITION F-13

SX	SY	MXX	MYY	T
-2910.	-0.	-0.	-0.	21300.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
1.28762E 01	1.46572E 02	-5.45244E-08	3.56366E 00	-7.85086E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
1.28762E 01	1.46572E 02	-5.45244E-08	3.56366E 00	-7.85086E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.25200E 00	1.25200E 00	2.34202E 00	3.55666E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-4.90890E-05	-0.	1.56267E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
2.29934E 00	5.46602E-01	0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	202.5079
CELL	1	202.5079
WEB	2	-271.6844
CELL	2	474.1922
WEB	3	-58.9344
CELL	3	-1.6904

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.96

22 AUG 63

CONDITION F-13

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				202.5079
	1	1.1722	0.	0.	154.1631
	2	3.4556	0.	0.	116.1736
	3	4.5474	0.	0.	59.2535
	4	4.5044	0.	0.	-2.6305
	5	3.3905	0.	0.	-50.3955
WEB	2				221.2889
	6	2.2413	0.	-0.	77.0641
	7	3.2563	-0.	-0.	33.6882
	8	4.3588	-0.	-0.	-19.0842
	9	3.2836	-0.	-0.	-51.5599
	10	1.0900	-0.	-0.	-60.6248
WEB	3				-60.6248
	11	1.0900	-0.	-0.	-51.5599
	12	3.2836	-0.	-0.	-19.0842
	13	4.3588	-0.	-0.	33.6882
	14	3.2563	-0.	-0.	77.0641
	15	2.2413	0.	-0.	221.2889
WEB	2				-50.3955
	16	3.3905	0.	0.	-2.6305
	17	4.5044	0.	0.	59.2535
	18	4.5474	0.	0.	116.1736
	19	3.4556	0.	0.	154.1631
	20	1.1722	0.	0.	202.5079
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
35.05	0.4810	1.000	-0.	-0.

T(TE)	2A(LE)	DS(LE)	T(LE)
-0.	154.60	34.600	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-40000.	320.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.18	2.12	18.18	-2.12	0.0250
2	0.	3.08	0.	-3.08	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	18.43	1.87	0.09	-0.	-0.	-0.	18.18	2.12	0.020	10.50
2	15.85	2.38	0.	-0.	-0.	-0.	15.85	2.38	0.020	0.
3	11.30	2.77	0.	-0.	-0.	-0.	11.30	2.77	0.020	0.
4	6.78	3.04	0.	-0.	-0.	-0.	6.78	3.04	0.020	0.
5	2.30	3.12	0.	-0.	-0.	-0.	2.30	3.12	0.020	0.
6	-0.25	2.83	0.18	-0.	-0.	-0.	0.	3.08	0.020	10.50
7	-0.25	-2.83	0.18	-0.	-0.	-0.	0.	-3.08	0.020	10.50
8	2.30	-3.12	0.	-0.	-0.	-0.	2.30	-3.12	0.020	0.
9	6.78	-3.04	0.	-0.	-0.	-0.	6.78	-3.04	0.020	0.
10	11.30	-2.77	0.	-0.	-0.	-0.	11.30	-2.77	0.020	0.
11	15.85	-2.38	0.	-0.	-0.	-0.	15.85	-2.38	0.020	0.
12	18.43	-1.87	0.09	-0.	-0.	-0.	18.18	-2.12	0.020	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-2910.	-0.	-55500.	-0.	17600.

NO. IT.	QXP(N)	QYP(N)
3	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
5.34288E 00	5.38623E 01	1.34265E 00	7.24244E 00	1.10579E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
5.34265E 00	5.38605E 01	1.34296E 00	7.24232E 00	1.10586E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
3.75551E-01	7.28811E-01	2.25133E 00	3.58671E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-8.32648E-05	0.	1.30059E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
3.87206E 00	5.91473E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	201.1714
CELL	1	201.1714
WEB	2	-320.6837
CELL	2	-19.3745

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				201.1714
	1	1.1722	7750.50	5071.93	167.4859
	2	3.4556	11075.75	11075.75	124.8491
	3	4.5474	16338.63	16338.63	46.9837
	4	4.5044	20339.25	20339.25	-49.0518
	5	3.3905	22343.26	22343.26	-127.8680
	6	1.1502	22524.61	19976.37	-340.0582 **
WEB	2				-340.0582 **
	7	0.2692	-41869.67 **	-39191.10	34.8772
	8	0.	-42887.31 **	-42887.31 **	34.8772
	9	0.	-43218.74 **	-43218.74 **	34.8772
	10	0.	-41574.41 **	-41574.41 **	34.8772
	11	0.	-38683.46 **	-38683.46	34.8772
	12	0.2881	-36572.84 **	-34024.60	201.1714
WEB	1				0.0000

** VALUE IS LESS THAN MINIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

CONDITION F-13

SX	SY	MXX	MYY	T
-2910.	-0.	-0.	-0.	21300.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
9.30011E 00	6.38779E 01	-5.37032E-08	7.76237E 00	-5.18962E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
9.30011E 00	6.38779E 01	-5.37032E-08	7.76237E 00	-5.18962E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
7.28811E-01	7.28811E-01	2.25133E 00	3.58671E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-1.02510E-04	0.	1.57400E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
4.76700E 00	6.17006E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	233.9686
CELL	1	233.9686
WEB	2	-282.5792
CELL	2	-12.3125

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 29.97

22 AUG 63

CONDITION F-13

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				233.9686
	1	1.1722	0.	0.	167.0342
	2	3.4556	0.	0.	114.4368
	3	4.5474	0.	0.	35.6298
	4	4.5044	0.	0.	-50.0500
	5	3.3905	0.	0.	-116.1817
	6	1.1502	0.	-0.	-294.8917
WEB	2				-294.8917
	7	1.1502	0.	-0.	-116.1817
	8	3.3905	0.	0.	-50.0500
	9	4.5044	0.	0.	35.6298
	10	4.5474	0.	0.	114.4368
	11	3.4556	0.	0.	167.0342
	12	1.1722	0.	0.	233.9686
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
32.70	0.4440	1.000	-0.	-0.

T(TE)	2A(LE)	DS(LE)	T(LE)
-0.	110.00	30.000	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-36000.	320.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.20	2.05	18.20	-2.05	0.0250
2	0.	2.85	0.	-2.85	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	18.45	1.80	0.09	-0.	-0.	-0.	18.20	2.05	0.020	10.50
2	15.88	2.29	0.	-0.	-0.	-0.	15.88	2.29	0.020	0.
3	11.32	2.67	0.	-0.	-0.	-0.	11.32	2.67	0.020	0.
4	6.82	2.90	0.	-0.	-0.	-0.	6.82	2.90	0.020	0.
5	2.28	2.92	0.	-0.	-0.	-0.	2.28	2.92	0.020	0.
6	-0.25	2.60	0.14	-0.	-0.	-0.	0.	2.85	0.020	10.50
7	-0.25	-2.60	0.14	-0.	-0.	-0.	0.	-2.85	0.020	10.50
8	2.28	-2.92	0.	-0.	-0.	-0.	2.28	-2.92	0.020	0.
9	6.82	-2.90	0.	-0.	-0.	-0.	6.82	-2.90	0.020	0.
10	11.32	-2.67	0.	-0.	-0.	-0.	11.32	-2.67	0.020	0.
11	15.88	-2.29	0.	-0.	-0.	-0.	15.88	-2.29	0.020	0.
12	18.45	-1.80	0.09	-0.	-0.	-0.	18.20	-2.05	0.020	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-2450.	-0.	-38500.	-0.	17300.

NO. IT.	QXP(N)	QYP(N)
3	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
4.08682E 00	4.94238E 01	6.80649E-01	7.93562E 00	1.14786E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
4.08657E 00	4.94220E 01	6.80898E-01	7.93551E 00	1.14795E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
3.76658E-01	7.29407E-01	2.06631E 00	3.04660E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-1.13746E-04	0.	1.64034E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
4.89646E 00	5.93739E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	202.7411
CELL	1	202.7411
WEB	2	-270.7655
CELL	2	-17.7710

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				202.7411
	1	1.1662	7182.55	4789.33	164.6120
	2	3.4541	9750.64	9750.64	119.3380
	3	4.5408	13932.13	13932.13	38.8979
	4	4.5230	16689.41	16689.41	-57.1938
	5	3.4106	17468.89	17468.89	-132.8720
	6	1.1405	17104.52	14776.34	-288.5365
WEB	2				-288.5365
	7	0.2875	-36719.37 **	-34326.15	28.5512
	8	0.	-37676.99 **	-37676.99 **	28.5512
	9	0.	-38078.76 **	-38078.76 **	28.5512
	10	0.	-36492.35 **	-36492.35 **	28.5512
	11	0.	-33497.33 **	-33497.33	28.5512
	12	0.3102	-31532.88 **	-29204.71	202.7410
WEB	1				-0.0000

** VALUE IS LESS THAN MINIMUM

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION F-13

SX	SY	MXX	MYY	T
-2450.	-0.	-0.	-0.	18600.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
7.76741E 00	5.88716E 01	-2.48922E-08	8.28272E 00	-3.54742E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
7.76741E 00	5.88716E 01	-2.48922E-08	8.28272E 00	-3.54742E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
7.29407E-01	7.29407E-01	2.06631E 00	3.04660E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-1.29655E-04	0.	1.76360E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
5.58132E 00	6.14682E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	218.8000
CELL	1	218.8000
WEB	2	-238.8471
CELL	2	-15.0055

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION F-13

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				218.8000
	1	1.1662	0.	0.	153.8823
	2	3.4541	0.	0.	102.8867
	3	4.5408	0.	0.	26.4369
	4	4.5230	0.	0.	-56.3146
	5	3.4106	0.	0.	-119.2281
	6	1.1405	0.	-0.	-253.8526
WEB	2				-253.8526
	7	1.1405	0.	-0.	-119.2281
	8	3.4106	0.	0.	-56.3146
	9	4.5230	0.	0.	26.4369
	10	4.5408	0.	0.	102.8867
	11	3.4541	0.	0.	153.8823
	12	1.1662	0.	0.	218.8000
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION UNIT SH

SX	SY	MXX	MYY	T
1000.	-0.	-0.	-0.	-21700.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
7.76741E 00	5.88716E 01	-2.48922E-08	8.28272E 00	-3.54742E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
7.76741E 00	5.88716E 01	-2.48922E-08	8.28272E 00	-3.54742E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
7.29407E-01	7.29407E-01	2.06631E 00	3.04660E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
5.29205E-05	0.	-2.05753E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
5.58132E 00	6.14682E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	-139.4500
CELL	1	-139.4500
WEB	2	86.8645
CELL	2	-33.3951

CONDITION FOR UNIT 1000# LOAD APPLIED AT HINGE FITTING

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 36.66

22 AUG 63

CONDITION UNIT SH

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				-139.4500
	1	1.1662	0.	0.	-112.9530
	2	3.4541	0.	0.	-92.1385
	3	4.5408	0.	0.	-60.9345
	4	4.5230	0.	0.	-27.1583
	5	3.4106	0.	0.	-1.4794
	6	1.1405	0.	-0.	53.4694
WEB	2				53.4694
	7	1.1405	0.	-0.	-1.4794
	8	3.4106	0.	0.	-27.1583
	9	4.5230	0.	0.	-60.9345
	10	4.5408	0.	0.	-92.1385
	11	3.4541	0.	0.	-112.9530
	12	1.1662	0.	0.	-139.4500
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 50.60

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
28.30	0.3460	1.000	-0.	-0.

T(TE)	2A(LE)	DS(LE)	T(LE)
-0.	60.00	20.600	0.0157

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-36000.	250.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.55	1.87	18.55	-1.87	0.0250
2	0.	2.30	0.	-2.30	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 50.60

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	18.80	1.62	0.09	-0.	-0.	-0.	18.55	1.87	0.016	10.50
2	16.26	2.08	0.	-0.	-0.	-0.	16.26	2.08	0.016	0.
3	11.66	2.44	0.	-0.	-0.	-0.	11.66	2.44	0.016	0.
4	6.96	2.59	0.	-0.	-0.	-0.	6.96	2.59	0.016	0.
5	2.34	2.47	0.	-0.	-0.	-0.	2.34	2.47	0.016	0.
6	-0.25	2.05	0.14	-0.	-0.	-0.	0.	2.30	0.016	10.50
7	-0.25	-2.05	0.14	-0.	-0.	-0.	0.	-2.30	0.016	10.50
8	2.34	-2.47	0.	-0.	-0.	-0.	2.34	-2.47	0.016	0.
9	6.95	-2.59	0.	-0.	-0.	-0.	6.96	-2.59	0.016	0.
10	11.66	-2.44	0.	-0.	-0.	-0.	11.66	-2.44	0.016	0.
11	16.26	-2.08	0.	-0.	-0.	-0.	16.26	-2.08	0.016	0.
12	18.80	-1.62	0.09	-0.	-0.	-0.	18.55	-1.87	0.016	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 50.60

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-1250.	-0.	-16000.	-0.	8700.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
2.74586E 00	4.89609E 01	6.68296E-01	7.96980E 00	8.96523E-01

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
2.74510E 00	4.89407E 01	6.78861E-01	7.96498E 00	8.96961E-01

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
3.02023E-01	5.83531E-01	1.59965E 00	2.36035E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-1.31900E-04	0.	1.48884E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
6.16603E 00	5.63881E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	120.0936
CELL	1	120.0936
WEB	2	-164.9429
CELL	2	-15.0417

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 50.60

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				120.0936
	1	1.1498	4832.21	3349.77	90.0122
	2	3.4568	6246.20	6246.20	62.1468
	3	4.6582	8724.88	8724.88	12.2456
	4	4.6620	9983.47	9983.47	-44.8304
	5	3.4839	9656.44	9656.44	-86.4889
	6	1.1731	8852.01	7410.14	-179.9846
WEB	2				-179.9846
	7	0.3218	-18051.63	-16569.20	7.1047
	8	0.	-19235.73	-19235.73	7.1047
	9	0.	-20312.37	-20312.37	7.1047
	10	0.	-19816.38	-19816.38	7.1047
	11	0.	-18084.06	-18084.06	7.1047
	12	0.3315	-17041.63	-15599.75	120.0936
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
21.60	0.1220	1.000	-0.	-0.

T(TE)	2A(LE)	DS(LE)	T(LE)
-0.	9.00	6.000	0.0157

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-36000.	250.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.94	1.62	18.94	-1.62	-0.
2	0.	1.24	0.	-1.24	-0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	19.19	1.37	0.09	-0.	-0.	-0.	18.94	1.62	0.016	10.50
2	16.56	1.86	0.	-0.	-0.	-0.	16.56	1.86	0.016	0.
3	11.80	2.11	0.	-0.	-0.	-0.	11.80	2.11	0.016	0.
4	7.06	2.01	0.	-0.	-0.	-0.	7.06	2.01	0.016	0.
5	2.36	1.61	0.	-0.	-0.	-0.	2.36	1.61	0.016	0.
6	-0.25	0.99	0.14	-0.	-0.	-0.	0.	1.24	0.016	10.50
7	-0.25	-0.99	0.14	-0.	-0.	-0.	0.	-1.24	0.016	10.50
8	2.36	-1.61	0.	-0.	-0.	-0.	2.36	-1.61	0.016	0.
9	7.06	-2.01	0.	-0.	-0.	-0.	7.06	-2.01	0.016	0.
10	11.80	-2.11	0.	-0.	-0.	-0.	11.80	-2.11	0.016	0.
11	16.56	-1.86	0.	-0.	-0.	-0.	16.56	-1.86	0.016	0.
12	19.19	-1.37	0.09	-0.	-0.	-0.	18.94	-1.62	0.016	10.50

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

CONDITION F-12

SX	SY	MXX	MYY	T
-300.	-0.	-1400.	-0.	3200.

NO. IT.	QXP(N)	QYP(N)
3	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
1.39682E 00	5.26682E 01	8.33125E-01	8.14362E 00	6.66678E-01

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
1.39766E 00	5.26806E 01	8.32720E-01	8.14373E 00	6.66193E-01

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
3.28008E-01	5.96773E-01	1.14297E 00	1.49897E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
-1.01932E-04	0.	9.75460E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
1.11463E 01	6.38034E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	48.0615
CELL	1	48.0615
WEB	2	-52.9229
CELL	2	-0.4029

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

CONDITION F-12

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				48.0615
	1	1.1960	791.92	535.13	34.6163
	2	3.5793	1072.65	1072.65	21.0908
	3	4.7538	1401.53	1401.53	-1.3210
	4	4.7290	1376.18	1376.18	-23.2193
	5	3.5529	1046.82	1046.82	-36.3842
	6	1.1944	710.40	461.60	-53.3258
WEB	2				-53.3258
	7	1.0196	-1797.37	-1540.58	-0.9720
	8	0.	-2209.24	-2209.24	-0.9720
	9	0.	-2688.84	-2688.84	-0.9720
	10	0.	-2865.73	-2865.73	-0.9720
	11	0.	-2689.01	-2689.01	-0.9720
	12	0.8672	-2484.36	-2235.56	48.0615
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

CONDITION UNIT SH

SX	SY	MXX	MYY	T
1000.	-0.	-0.	-0.	-21700.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
2.75749E 00	5.96116E 01	6.75271E-09	8.50010E 00	-5.77208E-09

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
2.75749E 00	5.96116E 01	6.75271E-09	8.50010E 00	-5.77208E-09

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
5.96773E-01	5.96773E-01	1.14297E 00	1.49897E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
3.30179E-04	0.	-6.61484E-04

S.C.(X)	S.C.(X/C)	S.C.(Y)
1.08315E 01	6.23461E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	-223.8052
CELL	1	-223.8052
WEB	2	104.0667
CELL	2	-30.4287

CONDITION FOR UNIT 1000# LOAD APPLIED AT HINGE FITTING

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
HORIZONTAL TAIL
STATION 70.16

22 AUG 63

CONDITION UNIT SH

ITEM		WP(EFF)	F(P)	F(S)	QP(MET)
WEB	1				-223.8052
	1	1.1960	0.	0.	-169.1408
	2	3.5793	0.	0.	-130.4074
	3	4.7538	0.	0.	-73.3005
	4	4.7290	0.	0.	-19.1725
	5	3.5529	0.	0.	14.6723
	6	1.1944	0.	-0.	73.6380
WEB	2				73.6380
	7	1.1944	0.	-0.	14.6723
	8	3.5529	0.	0.	-19.1725
	9	4.7290	0.	0.	-73.3005
	10	4.7538	0.	0.	-130.4074
	11	3.5793	0.	0.	-169.1408
	12	1.1960	0.	0.	-223.8052
WEB	1				-0.0000

HORIZONTAL STABILIZER

SUMMARY OF SPAR CAP MARGINS OF SAFETY

CRITICAL COND: F-12

STA.	FRONT SPAR			CENTER SPAR			REAR SPAR		
	f_c	F_c	M.S.	f_c	F_c	M.S.	f_c	F_c	M.S.
3.26	28186	45600	+.62	33342	47400	+.42	27183	38100	+.40
16.56	25602	38900	+.52	34437	49100	+.42	28310	↕	+.34
29.96	0			41066	45600	+.11	27733		+.37
36.66	-			34326	35600	+.04	29205		+.30
50.6	-			16569	35600	+1.15	15600		+1.44
70.16	-			1541	35600	HIGH	2236	38100	HIGH

HORIZONTAL STABILIZER

SPAR SHEAR ANALYSIS

FRONT SPAR INB'D B.L. 3.26

MAX. q = 513 #/IN. COND. AF-6

.025 BASIC WEB WITH .020 DBL. (7075-T6)

A_s = .080 (TWO .032 ANGLES)

$\frac{A_s}{bt} = \frac{.080}{3.26 \times .045} = .54$

ALLOW. q = 1.02 × 1030 = 1050 #/IN

(REF. BOEING DESIGN MANUAL, P. 15.62209)

$M.S. = \frac{1050}{513} - 1 = \underline{+1.05}$

FRONT SPAR OUTB'D B.L. 3.26

MAX. q = 163 #/IN. COND. F-12

.025 7075-T6 WEB

$\frac{A_s}{bt} = \frac{.080}{6.7 \times .025} = .48$

ALLOW. q = .99 × 520 = 514 #/IN.

$M.S. = \frac{514}{163} - 1 = \underline{+2.15}$

HORIZONTAL STABILIZER

CENTER SPAR INB'D B.L. 3.26

MAX. q = 1174 #/IN. COND. AF-6

.100 7075 - T6 WEB

A_s = .23 (ATTACH. FTG. 143T067)

$$\frac{A_s}{bt} = \frac{.23}{6.5 \times .1} = .35$$

ALLOW. q = .9 × 2920 = 2625 #/IN.

$$M.S. = \frac{2625}{1174} - 1 = +1.23$$

CENTER SPAR OUTB'D B.L. 3.26

MAX. q = 401 #/IN. COND. F-12 @ B.L. 3.26

.032 7075 - T6 WEB

A_s = .083 (.75 × .65 × .032 ANGLE & FLANGED .032 RIB)

$$\frac{A_s}{bt} = \frac{.083}{6.7 \times .032} = .39$$

ALLOW. q = .93 × 700 = 650 #/IN.

$$M.S. = \frac{650}{401} - 1 = +.62$$

HORIZONTAL STABILIZER

REAR SPAR INB'D B.L. 3.26

MAX. q = 510 #/IN. COND. AF-6

.025 7075-T6 WEB

A_s = .078 (2 .032 ANGLES, B.L. 3.26 RIB)

$$\frac{A_s}{bt} = \frac{.078}{6 \times .025} = .52$$

ALLOW. q = 1.01 × 520 = 525

$$M.S. = \frac{525}{510} - 1 = +\underline{1.03}$$

REAR SPAR OUTB'D B.L. 3.26

MAX. q = 236 #/IN COND. F-13 @ BL 3.16

.025 7075-T6 WEB

A_s = .038 (.032 ANGLE)

$$\frac{A_s}{bt} = \frac{.038}{6.7 \times .025} = .23$$

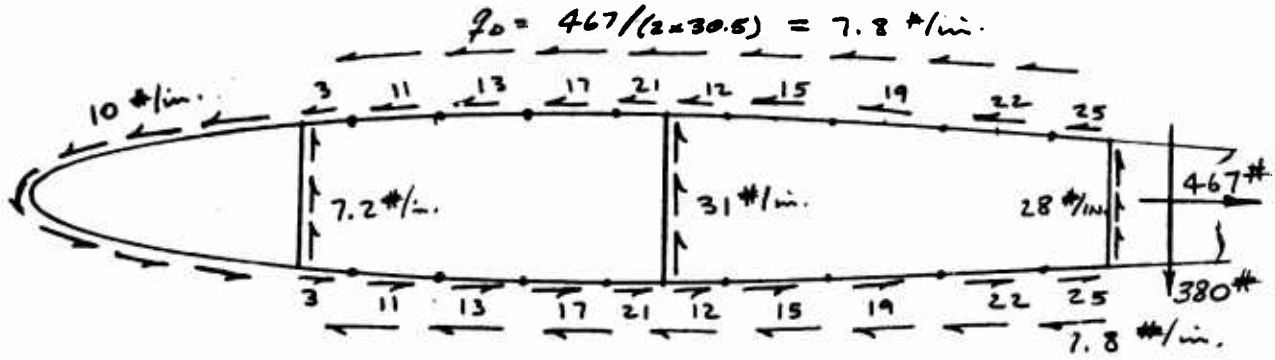
ALLOW. q = .80 × 520 = 416 #/IN.

$$M.S. = \frac{416}{236} - 1 = \underline{+.76}$$

HORIZONTAL STABILIZER

HINGE RIBS

THE HINGE RIB ANALYSES ARE SUMMARIZED BY SHOWING ONLY "FREE-BODY" DIAGRAMS WITH APPLIED HINGE LOADS AND REACTING SHEAR FLOWS. REACTING SHEAR FLOWS ARE DETERMINED FROM THE BOX BEAM OUTPUT FOR THE UNIT SHEAR CONDITIONS LABELED COND. SH



INBD HINGE RIB B.L. 3.26

COMPUTATION OF HG. LOAD:

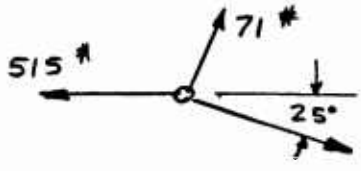
VERT. COMP. = 71 # CHORDWISE COMP = 1050 #

REF. P. 92

ULT. HG. MOMENT = 4110#

MOMENT ARM = 4

ACTUATING ROD LOAD = $\frac{4110}{4}$ = 1030 #
(REACTED EQUALLY AT THE INBD HINGES)

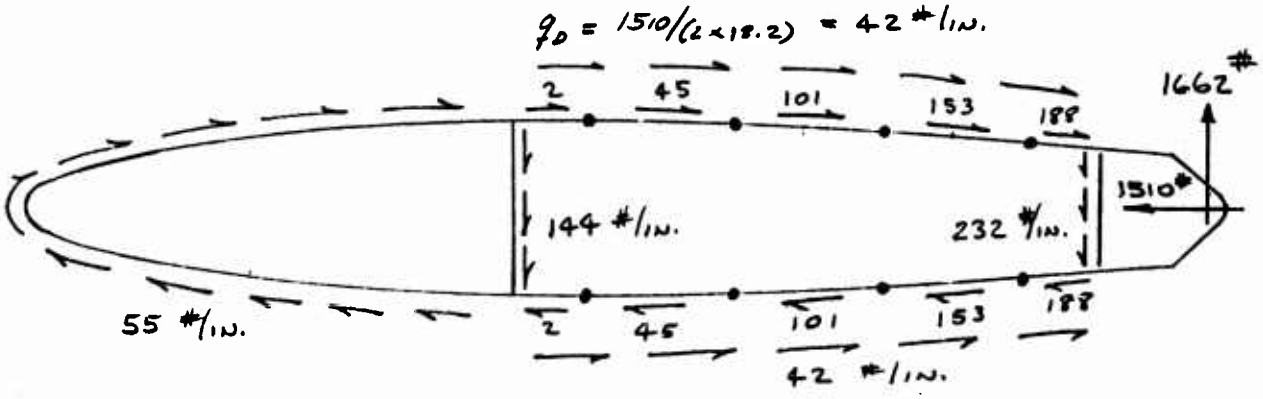


$V = 71 \cos 25° + 1050 \sin 25° = 380$ #

$D = 515 - 1050 \cos 25° - 71 \sin 25° = 467$ #

HORIZONTAL STABILIZER

HINGE RIBS

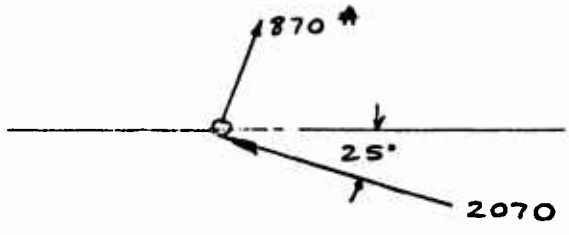


CENTER HINGE RIB B.L. 36.66

COMPUTATION OF HG. LOAD :

VERT. COMP. = 870 # CHORDWISE COMP = 2070 #

REF P. 82

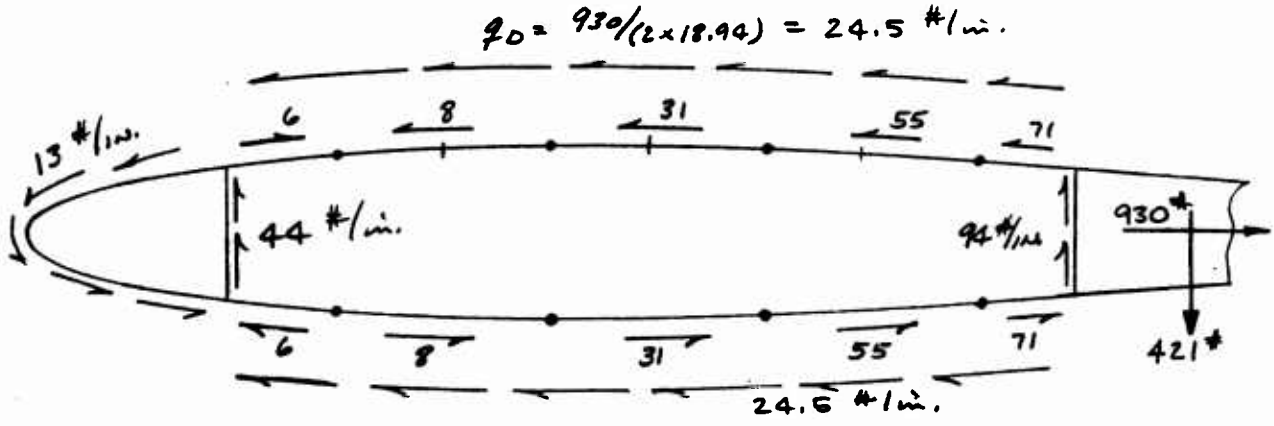


$V = 870 \cos 25° + 2070 \sin 25° = 1662$ #

$D = 2070 \cos 25° - 870 \sin 25° = 1510$ #

HORIZONTAL STABILIZER

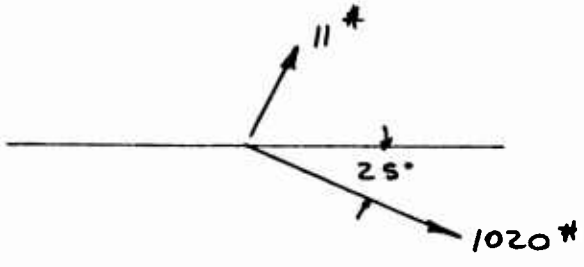
HINGE RIBS



OUTB'D HINGE RIB B.L. 70.16

COMPUTATION OF HG. LOAD :

VERT. COMP. = 11 # CHORDWISE COMP. = 1020 #
(REF P. 82)

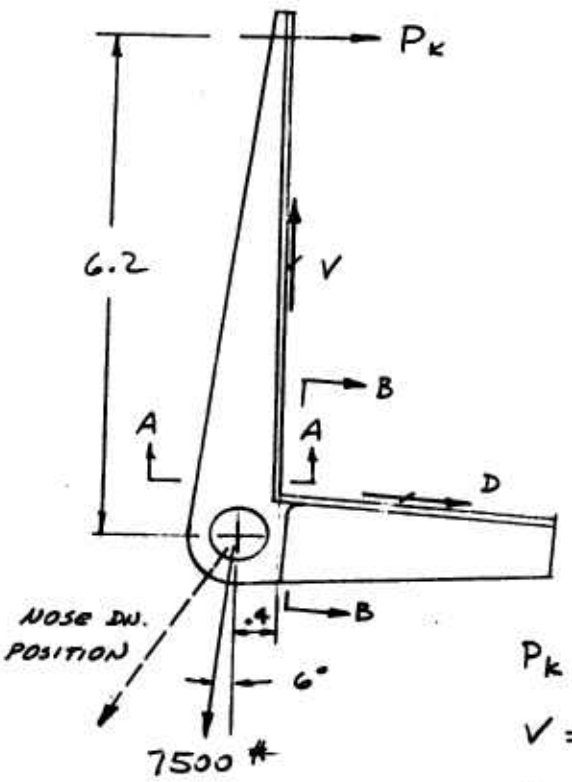


$V = 11 \cos 25° - 1020 \sin 25° = 421$ #

$D = -11 \sin 25° - 1020 \cos 25° = 930$

HORIZONTAL STABILIZER

ACTUATOR SUPPORT FITTING (DWG. 143T065)



MAT'L : 7075 - T651
EXTRUDED BAR

F_{tu} (L) = 81000 psi;
F_{tu} (T) = 66000 psi;

F_{cy} (L) = 72000 psi;
F_{cy} (T) = 69000 psi;

ULT. LOAD = 7500 #
(REF. P. 7)

$P_k = \frac{7500 \times .4}{6.2} = 484$ #

V = 7450 # (NOSE UP POSITION)

D = 4600 # (NOSE DN. POSITION)

LUG

a = .650 D = .6875 t = .332

USE MELCON - HOBLIT METHOD OF LUG ANALYSIS

W/D = 1.3/.6875 = 1.89

a/D = .65/.6875 = .945

D/t = .6875/.332 = 2.07

HORIZONTAL STABILIZER

ACTUATOR SUPPORT FITTING

LUG

$A_t = (1.3 - .6875) .332 = .2035$

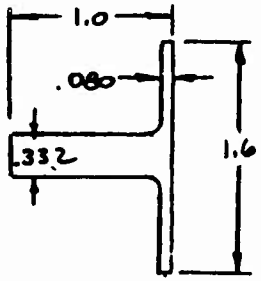
$A_{br} = .6875 \times .332 = .228$

$P_{tu} = .97 \times .2035 \times 66000 = 13000.\#$

$P_{bru} = .78 \times .228 \times 66000 = 11700$

$M.S. = \frac{11700}{7500} - 1 = \underline{+.56}$

SECTION A-A



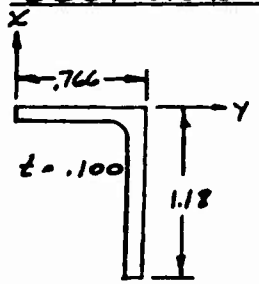
$A = .433 \qquad I = .04375 \qquad \bar{x} = .393$

$M = 7500 \times .393 - 484 \times 6.2 = -50 \text{"}\#$

$f_t = \frac{7500}{.433} + \frac{50 \times .61}{.04375} = 18000 \text{ psi}$

M.S. HIGH

SECTION B-B



$A = .1846 \qquad \bar{x} = -.577 \qquad \bar{y} = .395$

$I_x = .1493 \qquad I_y = .031$

$M_x = 4600 (.189 - .166) = 106 \text{"}\#$

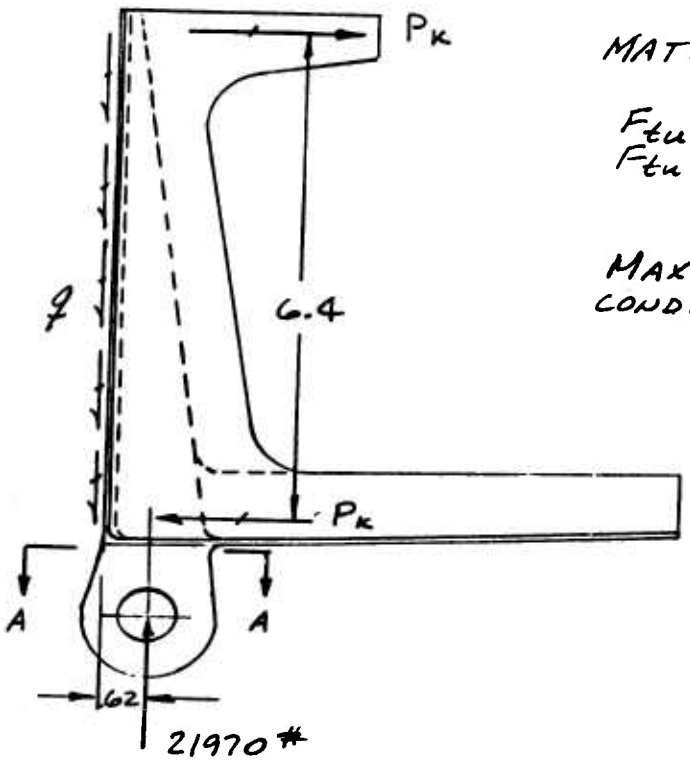
$M_y = 4600 \times .395 = 1816 \text{"}\#$

$f_t = \frac{4600}{.1846} + \frac{106 \times .189}{.031} + \frac{1816 \times .395}{.1493} = 30350 \text{ psi}$

$M.S. = \frac{66000}{30350} - 1 = \underline{+1.18}$

HORIZONTAL STABILIZER

HORIZ. STAB. PIVOT FITTING (DWG 143T067)



MAT'L: 7075-T651 ROLLED BAR

F_{tu} (L) = 77000 psi
F_{tu} (T) = 70000 psi

MAX. LOAD = 21970 #
COND. AF-6 REF. P. 7

$$P_K = \frac{21970 \times .62}{6.4} = 2120\ \#$$

ATTACHMENT TO CENTER SPAR WEB:

9 BJS TO .032 OUTB'D WEB

9 3/16 LOCKBOLTS TO .100 INB'D WEB

TOTAL ALLOWABLE = $9(.9 \times 596 + 2620) = 28400\ \#$

$$M.S. = \frac{28400}{21970} - 1 = +.29$$

HORIZONTAL STABILIZER

HORIZ. STAB. PIVOT FITTING

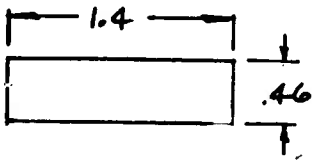
ATTACHMENT TO RIB UPR. CAP:

4 5/32 RIVETS

ALLOW. SHEAR = $4 \times 596 = 2380$ #

$$M.S. = \frac{2380}{2120} - 1 = \underline{+.12}$$

SECT. A-A :



$A = 1.4 \times .46 = .645$

$$f_c = \frac{21970}{.645} = 34200 \text{ psi}$$

$F_{cy} = 66000$ psi

$$M.S. = \frac{66000}{34200} - 1 = \underline{+.93}$$

III. ELEVATOR

The elevator design loading is based on maximum torque input due to pilot effort. A conservative chordwise pressure distribution is assumed as shown on page 75. The torque about the hinge line resulting from the surface air load is equated to the torque applied by maximum pilot effort to find the magnitude of the air load. This load is greater than any load required to maneuver or balance the airplane within the design flight envelope.

Elevator hinge loads are found by solving the standard three-moment equations. The effect of hinge deflections induced by horizontal stabilizer deflection is included. Since the induced hinge deflections increase the center hinge load and reduce the inboard and outboard hinge loads, an additional arbitrary condition is considered to find conservative values for the outer hinge loads. This condition assumes zero moment at the center hinge.

The preliminary analysis is used for the final analysis. Since the preliminary analysis is based on a lower load than the final load, it is necessary to increase the results by the ratio of loads (951/705 = 1.35). The first analysis was also modified to include effect of the connecting torque tube being capable of taking the bending moment across the centerline.

The final stress analysis is brief since the complete structure was sucessfully proof tested and the design load is conservative.

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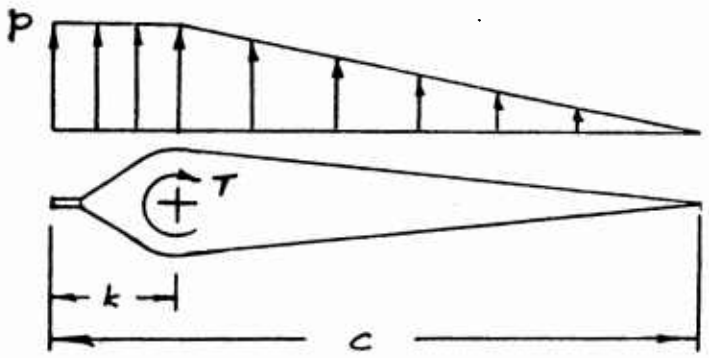
8/13/63

ELEVATOR

LOADING

USE FOLLOWING CHORDWISE PRESSURE DISTRIBUTION.



$c_i = 19.89$
$c_o = 12.68$

$k = .194\ c$

$$\Delta T = \frac{pc^2}{6}(2k^2 + 2k - 1)\,dx = -.0895\,pc^2\,dx$$

$$T = \int_0^{5.65} -.0895\,pc^2\,dx \qquad c = 12.68 + .1098x$$

$$T = 1584\,p$$

ULT. PIVOT EFFORT TORQUE PER SIDE = 2055 "#

$$2055 = 1584\,p$$

$$p = 1.297 \text{ psi (ULT.)}$$

$$w = \frac{pc}{2}(k+1) = .775\,c$$

$$w_i = .775 \times 19.89 = 15.4 \text{ \#/IN.}$$

$$w_o = .775 \times 12.68 = 9.8 \text{ \#/IN.}$$

TOTAL LOAD = $\left(\frac{15.4+9.8}{2}\right)65.65 = 830$ # ULT. *

* A TOTAL LOAD OF 951 # WAS USED FOR ORIGINAL DESIGN AND PROOF TEST. THEREFORE 951 # LOAD WILL BE USED FOR FINAL ANALYSIS.

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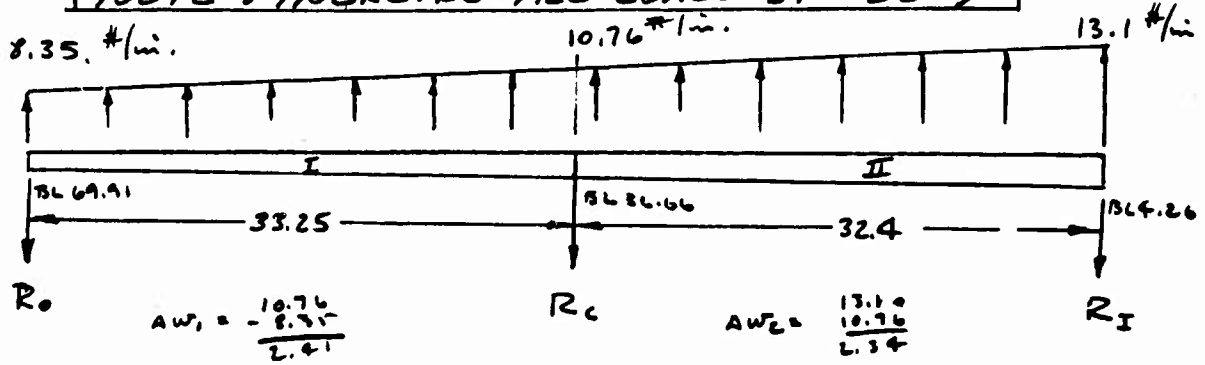
ELEVATOR HINGE LOADS

NOTE: INCREASE ALL LOADS BY 35%



Av. I_I = .28
Av. I_{II} = .47

} REF. ELEVATOR DEFLECTION 10/23/62

ABOVE LOAD BASED ON ASSUMED PRESSURE DISTRIBUTION CALCULATED ON 11/7/62

INCLUDE SPT. DEFLECTIONS BASED ON MAX. STAB. DEFLECTION:

$\delta_o = 1.44$ $\delta_c = .38$ $\delta_I = 0$

USE THREE-MOMENT EQ. TO SOLVE FOR M_c

$$\frac{2M_cL_1}{I_1} + \frac{2M_cL_2}{I_2} = \frac{w_1L_1^3}{4I_1} + \frac{2\Delta w_1L_1^3}{15I_1} + \frac{w_2L_2^3}{4I_2} + \frac{7\Delta w_2L_2^3}{60I_2} + \frac{6E}{L_1}(\delta_o - \delta_c) + \frac{6E}{L_2}(\delta_I - \delta_c)$$

$$\left(\frac{2\times 33.25}{.28} + \frac{2\times 32.4}{.47}\right)M_c = \left(\frac{8.35}{4} + \frac{2\times 2.41}{15}\right)\frac{33.25^3}{.28} + \left(\frac{10.76}{4} + \frac{7\times 2.34}{60}\right)\frac{32.4^3}{.47} + \frac{6\times 10.5\times 10^6}{33.25}(1.44 - .38) + \frac{6\times 10.5\times 10^6}{32.4}(0 - .38)$$

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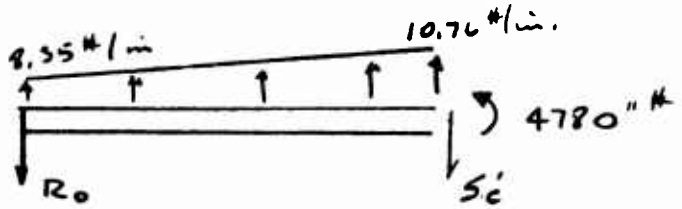
ELEVATOR HINGE LOAD

$$376\ M_c = 2.407 \times 131200 + 2.963 \times 72400 + (1.893 \times 1.06 + 1.943 \times -.38)10^6$$

$$376\ M_c = 316500 + 214500 + 1266000$$

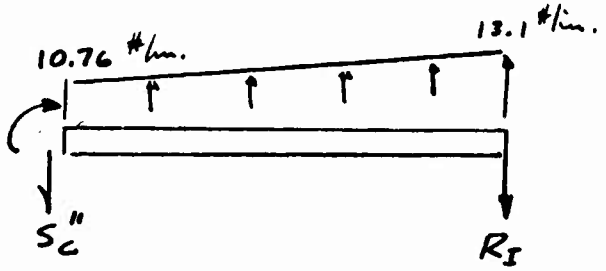
$$M_c = 4780\ "\#$$



$$33.25\ R_o = 8.35 \times \frac{33.25^2}{2} + 2.41 \times \frac{33.25^2}{6} - 4780$$

$$R_o = 8\ \#$$

$$S_c' = \left(\frac{8.35 + 10.76}{2}\right) 33.25 - 8 = 310\ \#$$



$$32.4\ S_c'' = 10.76 \times \frac{32.4^2}{2} + 2.34 \times \frac{32.4^2}{6} + 4780$$

$$S_c'' = 334\ \#$$

$$R_I = \left(\frac{10.76 + 13.1}{2}\right) 32.4 - 334 = 53\ \#$$

$$R_c = 310 + 334 = 644\ \#$$

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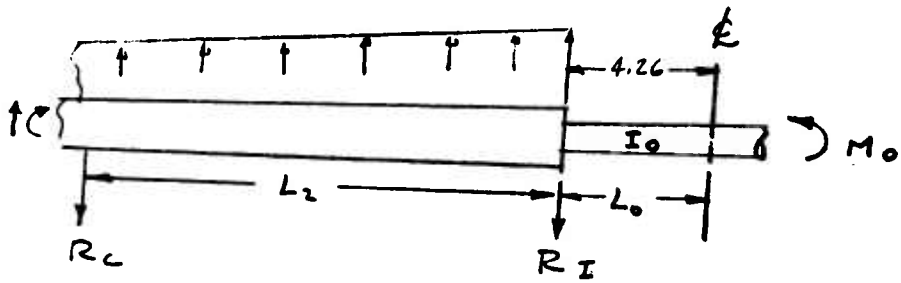
ELEVATOR HG. LOAD

WORK DONE ON 11/7/62 IS REVISED TO INCLUDE EFFECT OF CONTINUOUS TORQUE TUBE ACROSS ℄



1.56 × .08 TUBE (STEEL)

$I = \frac{\pi}{4}(.78^4 - .70^4) = .102$

I (EQUIV FOR AL. AL. E) $= \frac{29}{10.5} \times .102 = .282$

$$\frac{2 M_C L_1}{I_1} + \frac{2 M_C L_2}{I_2} + \frac{M_I L_2}{I_2} = f(w) + f(\delta)$$

$$376 M_C + 69 M_I = 1797000 \quad \text{-------} \quad (1)$$

$$\frac{M_C L_2}{I_2} + \frac{2 M_I L_2}{I_2} + \frac{2 M_I L_o}{I_o} + \frac{M_o L_o}{I_o} = \frac{10.76 \times 32.4^3}{4 I_2}$$

$$+ \frac{2 \times 2.34 \times 32.4^3}{15 I_2} + \frac{6E}{I_2}(\delta_c - \delta_I) + \frac{6E}{I_o}(\delta_o - \delta_I)$$

$$M_C \times \frac{32.4}{.47} + 2 M_I \left(\frac{32.4}{.47} + \frac{4.26}{.282}\right) + M_o \times \frac{4.26}{.282} = 194200 + 22600$$

$$+ \frac{6 \times 10.5 \times 10^6}{47}(.38 - 0)$$

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ELEVATOR HG. LOAD

$M_O = M_I$ (NO SHEAR ACROSS ℄)

$$69\,M_C + 183.3\,M_I = 726800 \quad \text{---------- (2)}$$

$$\begin{array}{rl} & 376\,M_C + 69\,M_I = 1797000 \\ - & 376\,M_C - 1000\,M_I = -3960000 \\ \hline & -931\,M_I = -2163000 \end{array}$$

$$M_I = 2320 \text{ "\#}$$

$$376\,M_C = 1797000 - 69 \times 2320$$

$$M_C = 4350 \text{ "\#} \quad \text{(VS. 4780 "\# WITHOUT CENTER TUBE CONTINUITY)}$$

ULT. HG. MOMENT = 2055 "#

ROD LOAD = $2055/4 = 514$ #

CHORDWISE B.M. = $\frac{514}{2} \times 4.26 = 1090$ '#

RES. B.M. = $(2320^2 + 1090^2)^{1/2} = 2570$ "#

$$f_b = \frac{2570 \times .78}{.102} = 19700 \text{ psi}$$

M.S. HIGH

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11/7/62

ELEVATOR HG. LOADS

CHORDWISE LOADS

CHORDWISE DEFLECTIONS = δ SIN 25°

$\delta_c' = .38 \times .422 = .16$

$\delta_o' = 1.44 \times .422 = .609$

MOMENT OF INERTIA:

ASSUME .02 HAG. SKIN — FULLY EFFECTIVE

$C_I = 14.5$ $\qquad I_I = \frac{2 \times .02 \times 14.5^3}{12} = 10.2$

$C_{II} = 18.1$ $\qquad I_{II} = \frac{2 \times .02 \times 18.1^3}{12} = 19.7$

$$\frac{2 M_c L_1}{I_1} + \frac{2 M_c L_2}{I_2} = \frac{6E}{L_1}(\delta_o - \delta_c) + \frac{6E}{L_2}(\delta_I - \delta_c)$$

$$\left(\frac{2 \times 33.25}{10.2} + \frac{2 \times 32.4}{19.7}\right) M_c = \frac{6 \times 6.5 \times 10^6}{33.25}(.609 - .16) + \frac{6 \times 6.5 \times 10^6}{32.4}(0 - .16)$$

$$9.82\, M_c = 333000$$

$$M_c = 34000 \text{ "\#}$$

$R_o = \frac{34000}{33.25} = 1020$ # $\qquad R_I = \frac{34000}{32.4} = 1050$ #

$R_c = 1020 + 1050$

$= 2070$ #

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ELEVATOR HG. LOADS

INBD & OUTBD HG. LOADS

CONSIDER SURFACE PINNED @ CENTER HINGE TO DETERMINE MAX. LOADS

SEE LOADS & GEOMETRY ON P. 2

$$33.25\,R_o = 8.35 \times \frac{33.25^2}{2} + 2.41 \times \frac{33.25^2}{6}$$

$$R_o = 5054/33.25 = 152\ \#$$

$$S'_c = \left(\frac{8.35+10.76}{2}\right)33.25 - 152 = 166\ \#$$

$$32.4\,S''_c = 10.76 \times \frac{32.4^2}{2} + 2.34 \times \frac{32.4^2}{6}$$

$$S''_c = 6050/32.4 = 187\ \#$$

$$R_I = \left(\frac{10.76+13.1}{2}\right)32.4 - 187 = 200\ \#$$

$$R_c = 166 + 187 = 353\ \#$$

NOTE: INCREASE LOADS BY 35%

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ELEVATOR

SUMMARY OF HINGE LOADS

	OUTB'D HG.	CENTER HG.	INB'D HG.
		VERTICAL LOADS	
CONTINUOUS BEAM OVER CENTER SUPPORT	± 11 #	± 870 #	± 71 #
		CHORDWISE LOADS	
	+ 1020 #	- 2070 #	+ 1050 #
		VERTICAL LOADS	
ZERO MOMENT @ CENTER SUPPORT	± 205 #	± 477 #	± 270 #

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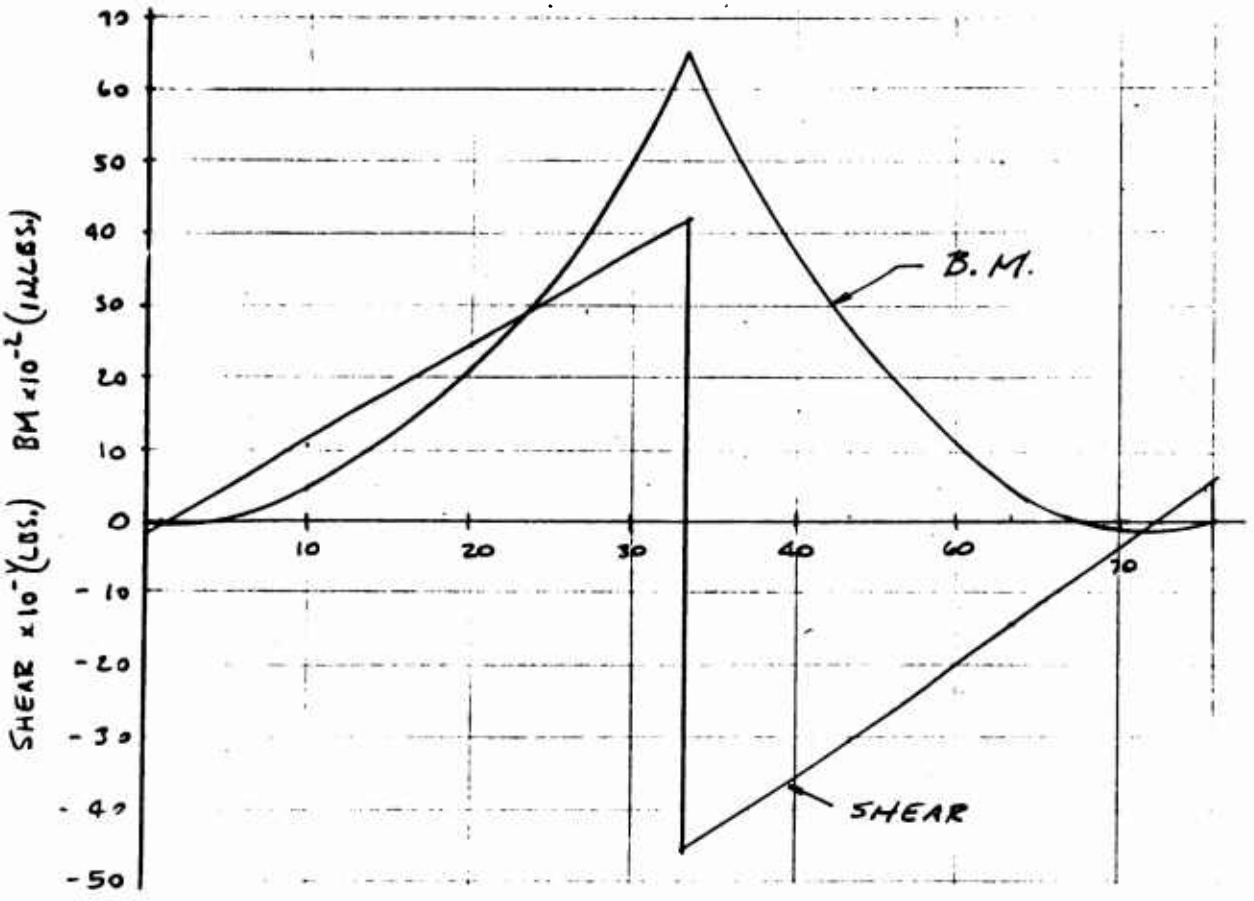
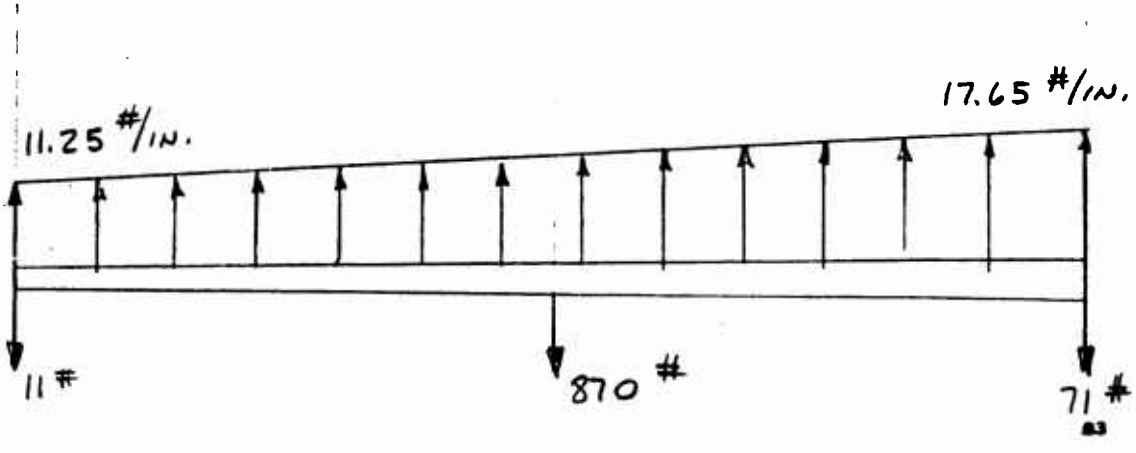
ELEVATOR

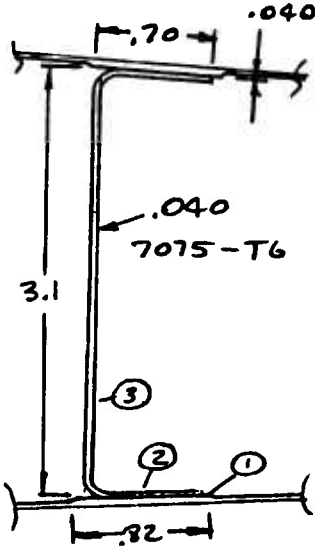
ULT. SHEAR & B.M.





ELEVATOR

BENDING CHECK AT CENTER HINGE



EFF. SKIN $A = 2 \times .04 \times .82 \times \frac{6.5}{10.5} = .0405$

ELE	A	$\bar{z}$	Az^2	I_o
1	.0405	1.57	.100	0
2	.0528	1.53	.1238	0
3	.121	0	0	.0916
Σ			.2238	.0916

$I = .3154$

MAX. B.M. = 6450 "#

$$f_{bc} = \frac{6450 \times 1.53}{.3154} = 31300 \text{ psi}$$

FIND ALLOWABLE CRIPPLING STRESS BY METHOD GIVEN IN RYAN STRUCTURES MANUAL, P. 5.9

$$\frac{b'}{t} = .68/.04 = 17$$

$$\frac{F_{cc}}{\sqrt{F_{cy} E}} = .039$$

$$F_{cc} = .039\sqrt{68000 \times 10.5 \times 10^6} = 33000 \text{ psi}$$

$$M.S. = \frac{33000}{31300} - 1 = +.05$$

IV. VERTICAL STABILIZER

Description of Structure

The vertical stabilizer is a three-spar conventional semi-monocoque structure. The skin is stiffened by closely spaced ribs. The horizontal stabilizer is attached to the tip of the vertical stabilizer by means of symmetrically placed pivot fittings at the center spar and the actuator link attached to the centerline of the front spar. Attachment to the fuselage is provided by frames or bulkheads which are designed as integral parts of the spars. The skins are attached to the fuselage skins by drag angles which also function as fuselage longerons.

Critical Conditions

Two critical conditions are considered as follows:

LG-4 - max. shear and bending moment
(asym. flight - lateral gust, V (G) = 40 FPS, aft C. G., n_z = 1.0,
q = 595 PSF, mach = 0.638)

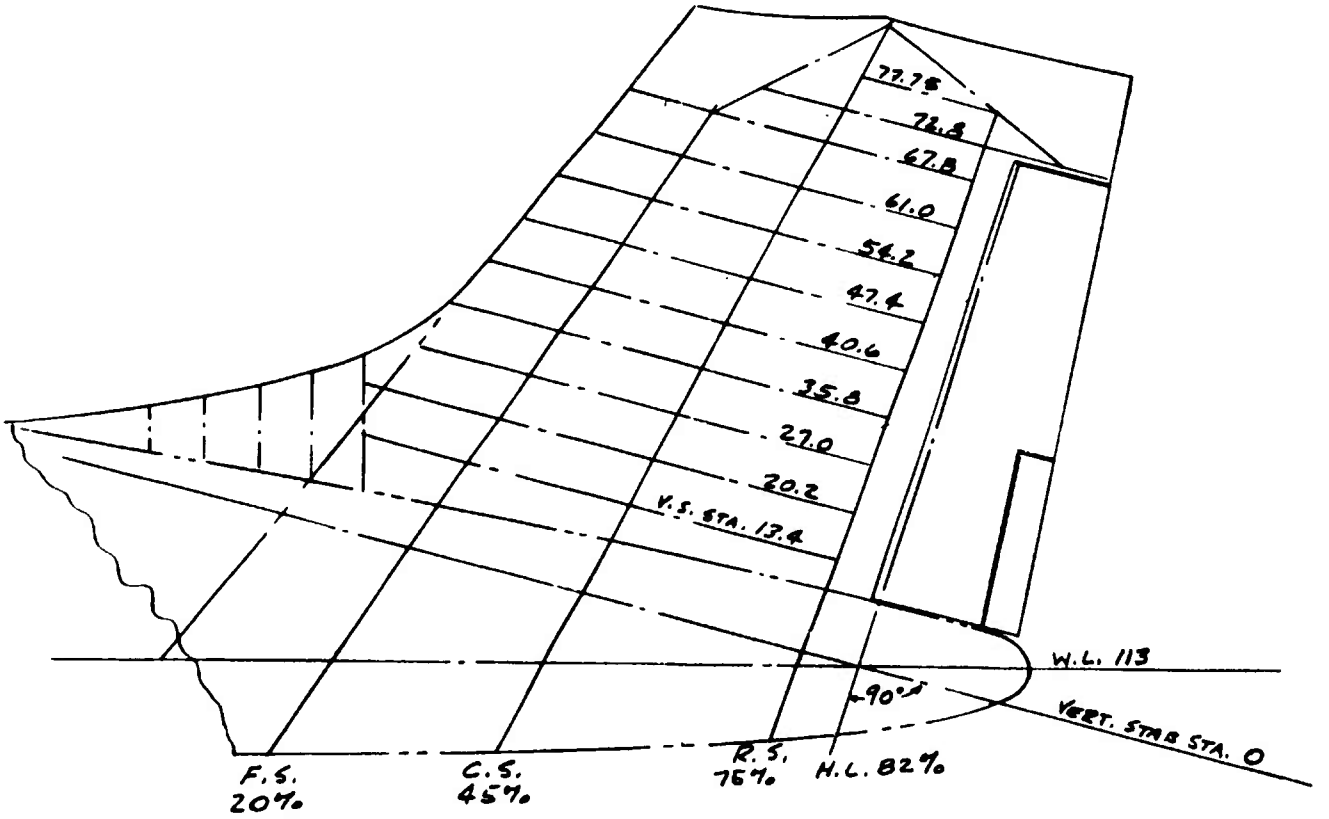
AF-10 - max. torsion
(rudder kick, aft C.G. n_z = 1.0, q = 595 PSF, mach = 0.638)

Loads curves (shear, B. M. and torque) for these conditions are shown on pages 88, 89 and 90.

Method of Analysis

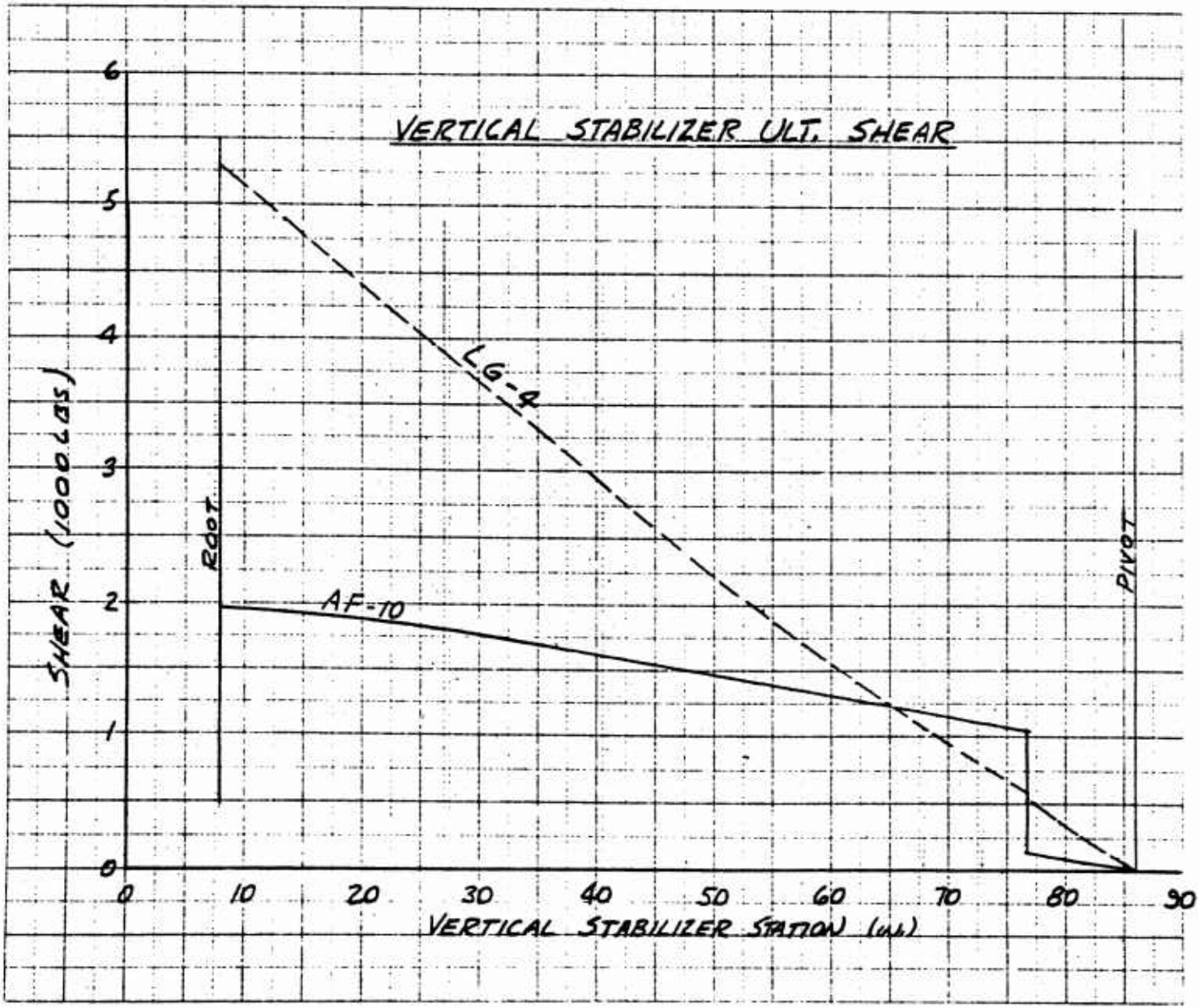
Bending stresses and shear flows are computed by a digital computer using ordinary engineering gheory. The program used is described in Ryan Report 62B118. "Description of Box Beam Program for IBM Job No. 1012", 18 Nov. 1962. No tension skin is effective at the root section (V. S. STA. 13. 4) since the fin/fuselage skin joint cannot transmit skin bending stresses.

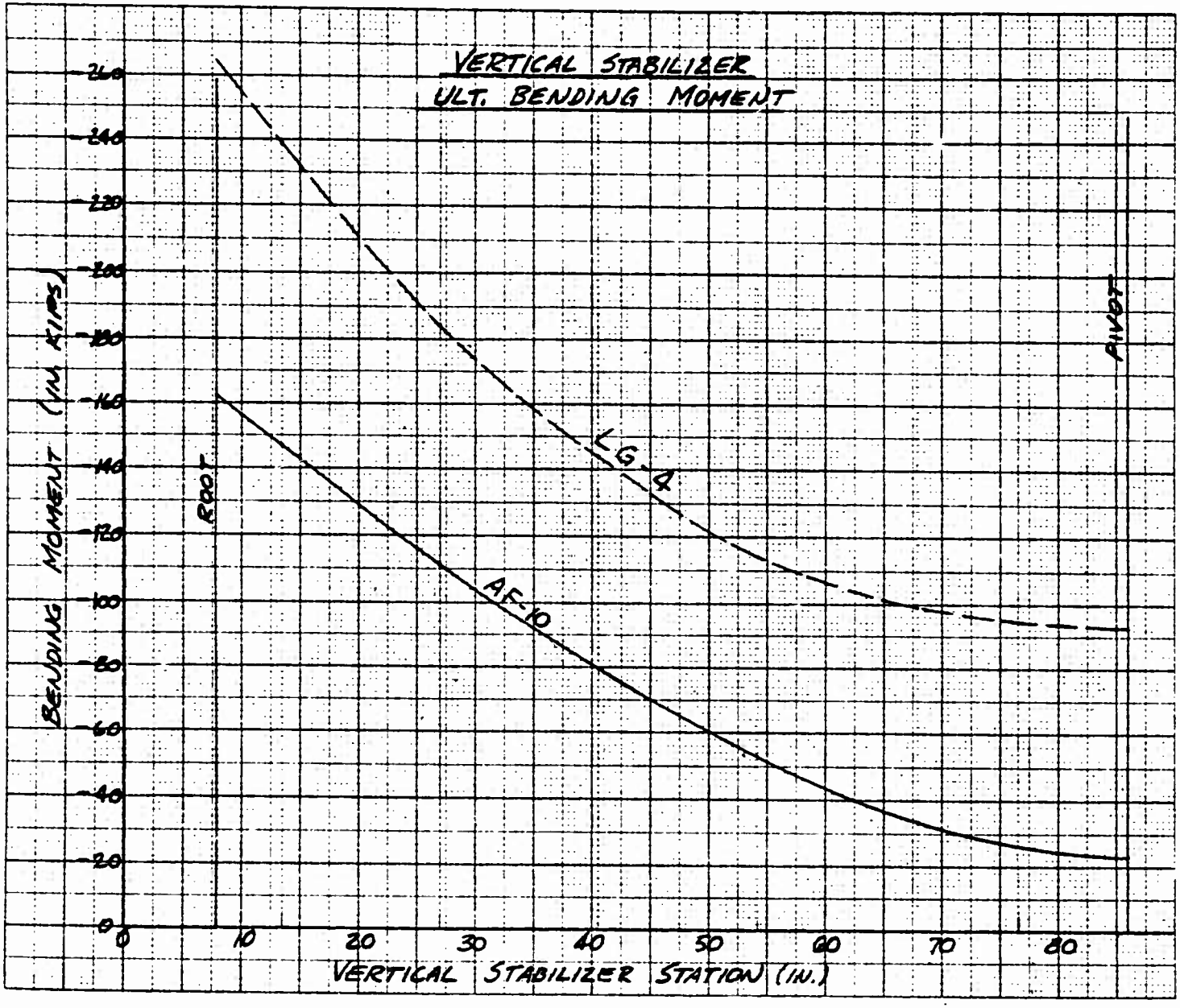
The computed bending stresses (based on Mc/I) near the fuselage attachment are not accurate, since the sweep effect has been neglected. These rear spar stresses are low (on the order of 30%), but it is believed that a more exact analysis is not necessary, since the root section margins of safety are ample. These high margins resulted from a substantial load reduction after the design was completed.

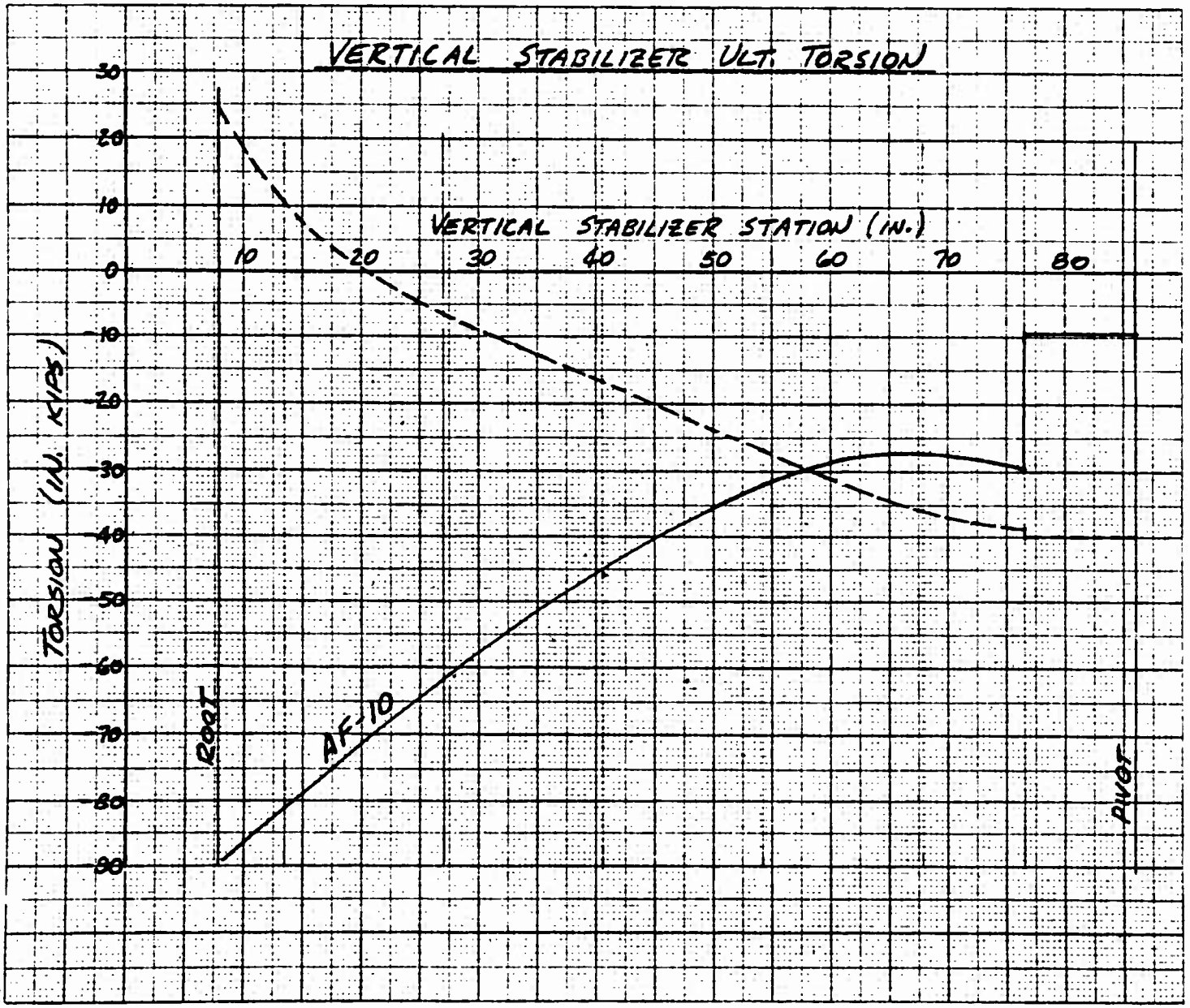


VERTICAL STABILIZER

(REF. DWG 143T004)


VERTICAL STABILIZER ULT. SHEAR
SHEAR (1000 LBS)
VERTICAL STABILIZER STATION (in.)
LG-4
AF-10
RDOT
PIVOT
0
1
2
3
4
5
6
0
10
20
30
40
50
60
70
80
90


VERTICAL STABILIZER
ULT. BENDING MOMENT
BENDING MOMENT (IN KIPS)
260
240
220
200
180
160
140
120
100
80
60
40
20
0
ROOT
PIVOT
LG 4
AF-10
0
10
20
30
40
50
60
70
80
VERTICAL STABILIZER STATION (IN.)


VERTICAL STABILIZER ULT. TORSION
VERTICAL STABILIZER STATION (IN.)
TORSION (IN. KIPS)
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
10
20
30
40
50
60
70
80
ROOT
PIVOT
AF-10

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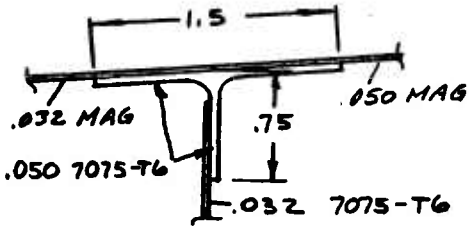
VERTICAL STABILIZER
(DWG 143T003)

FRONT SPAR CAP AREAS (DWG. 143T005)

CONSTANT SECTION FROM ROOT TO STA. 67.80



EFF. t OF MAG. SKINS

t_e (.050) = $\frac{6.5}{10.5} \times .05 = .031$

t_e (.032) = $\frac{6.5}{10.5} \times .032 = .020$

ASSUME 15 t EFFECTIVE WIDTH OF SKIN ON EACH SIDE OF RIVET

AREA:

TEE	=	.110
.050 SKIN (.38 + 15×.031).031	=	.0262
.032 SKIN (.38 + 15×.02).02	=	.0136
.032 WEB (.31 + 15×.032).032	=	.0252
		.1750

CRIPPLING ALLOWABLE:
(REF BOEING DESIGN MANUAL FIG. 1 SECT. 15.231)

$\frac{A}{\Sigma t^2} = \frac{.11}{3 \times .05^2} = 14.7$

F_{cr} = 42500 psi

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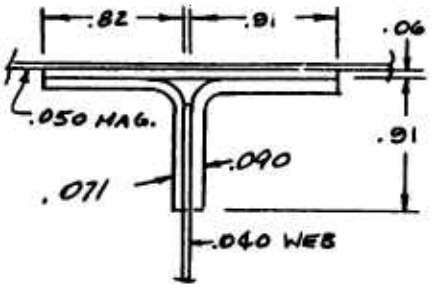
VERTICAL STABILIZER

CENTER SPAR CAP AREAS (DWG. 143 T 007)

CONSTANT SECTION FROM V.S.S. 13.40 TO 67.80



ALL MAT'L 7075-T6 EXCEPT SKIN

AREA:

.071 ANGLE	= .112
.090 ANGLE	= .148
.060 STRAP	= .106
.050 SKIN (1.01+30×.031).031	= .06
.040 WEB (.31+15×.04).04	= .036
	.462

CRIPPLING ALLOWABLE:
(REF. RYAN STRUCTURES MANUAL)

.090 ANGLE $b'/t = .865/.09 = 9.6$

$F_{cr} = .057\sqrt{68000 \times 10.5\times10^6} = 48100$ psi

.071 ANGLE $b'/t = \frac{.784+.864}{2\times.071} = 11.6$

$F_{cr} = .05\sqrt{68000\times10.5\times10^6} = 42300$ psi

$$\text{Av. } F_{cr} = \frac{48100\times.148 + 42300\times.112}{.148+.112}$$

$$= 45600 \text{ psi}$$

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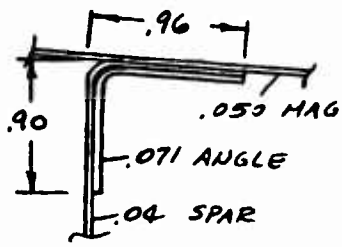
VERTICAL STABILIZER

REAR SPAR CAP AREAS (DWG. 143T009)

SECTION @ V.S.S. 13.40



AREA SPAR = .071
" ANGLE = .116
" SKIN (30×.031).031 = .029
.216

CRIPPLING ALLOWABLE

.040 FLG. $b/t = .94/.040 = 23.5$

$F_{cc} = .03\sqrt{68000 \times 10.5 \times 10^6} = 20400$ psi

.071 ANGLE $b/t = \frac{.844+.904}{2\times.071} = 12.3$

$F_{cc} = .047\sqrt{68000 \times 10.5 \times 10^6} = 39800$ psi

$$\text{Av. } F_{cc} = \frac{20400\times.071 + 39800\times.116}{.071+.116} = 32400 \text{ psi}$$

SECTION FROM V.S.S. 20.20 TO V.S.S. 40.60

DEPTH OF .071 ANGLE IS REDUCED TO .72

AREA SPAR = .064
" ANGLE = .104
" SKIN = .029
.197

b/t (OF .071 ANGLE) $= \frac{.609+.904}{2\times.071} = 10.7$

$F_{cc} = .053\sqrt{68000 \times 10.5 \times 10^6} = 44900$ psi

$$\text{Av. } F_{cc} = \frac{20400\times.064 + 44900\times.104}{.064+.104} = 35600 \text{ psi}$$

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VERTICAL STABILIZER

REAR SPAR CAP AREAS

SECTION FROM V.S.S. 47.40 TO 77.75

NESTED .071 ANGLE IS DROPPED AT V.S.S. 40.60 AND SPAR FLANGE WIDTH IS REDUCED TO .78 AT V.S.S. 47.40

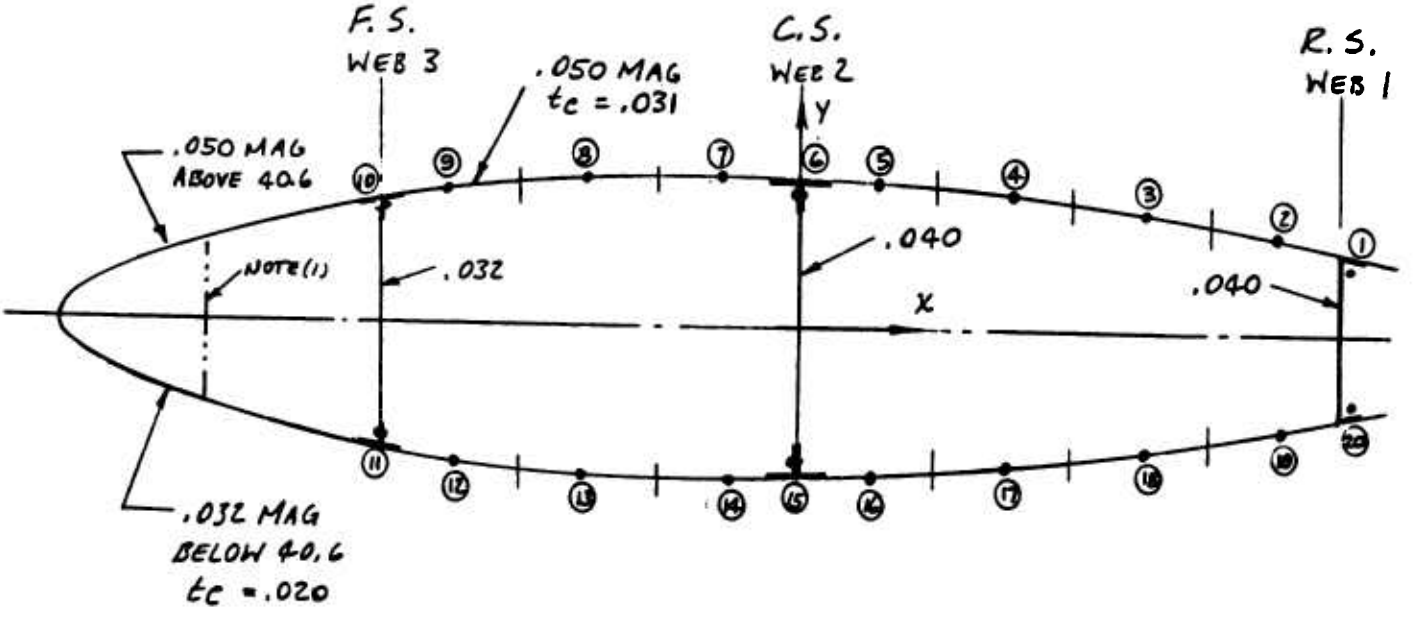
AREA SPAR = .059
" SKIN = .029
.088

CRIPPLING ALLOWABLE :

.040 FLG. — $b/t = .76/.04 = 19$

$F_{cc} = .034\sqrt{68000 \times 10.5 \times 10^6} = 28800$ psi

TYPICAL SECTION VERTICAL STABILIZER



ONLY SKIN IN TENSION IS CONSIDERED EFFECTIVE. NO SKIN IS CONSIDERED EFFECTIVE AT V.S.S. 13.40 BECAUSE OF DISCONTINUITY AT FUSELAGE INTERSECTION.

NOTE (1) LEADING EDGE OF SECTION @ V.S.S. 13.40 IS ASSUMED TO TERMINATE ON DORSAL FRAME F.S. 432.80 .

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
60.28	0.5600	1.000	0.	0.

T(TE)	2A(LE)	DS(LE)	T(LE)
0.	332.00	37.900	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-45600.	500.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	26.52	4.05	26.52	-4.05	0.0400
2	0.	7.25	0.	-7.25	0.0400
3	-20.56	6.80	-20.56	-6.80	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	26.77	3.80	0.22	-0.	-0.	-0.	26.52	4.03	-0.031	0.
2	23.21	4.60	0.	-0.	-0.	-0.	23.21	4.60	-0.031	0.
3	16.59	5.61	0.	-0.	-0.	-0.	16.59	5.61	-0.031	0.
4	9.97	6.44	0.	-0.	-0.	-0.	9.97	6.44	-0.031	0.
5	3.35	7.06	0.	-0.	-0.	-0.	3.35	7.06	-0.031	0.
6	0.	7.00	0.46	-0.	-0.	-0.	0.	7.25	-0.031	0.
7	-3.42	7.33	0.	-0.	-0.	-0.	-3.42	7.33	-0.031	0.
8	-10.26	7.25	0.	-0.	-0.	-0.	-10.26	7.25	-0.031	0.
9	-17.10	6.98	0.	-0.	-0.	-0.	-17.10	6.98	-0.031	0.
10	-20.56	6.55	0.17	-0.	-0.	-0.	-20.56	6.80	-0.031	0.
11	-20.56	-6.55	0.17	-0.	-0.	-0.	-20.56	-6.80	-0.031	0.
12	-17.10	-6.98	0.	-0.	-0.	-0.	-17.10	-6.98	-0.031	0.
13	-10.26	-7.25	0.	-0.	-0.	-0.	-10.26	-7.25	-0.031	0.
14	-3.42	-7.33	0.	-0.	-0.	-0.	-3.42	-7.33	-0.031	0.
15	0.	-7.00	0.46	-0.	-0.	-0.	0.	-7.25	-0.031	0.
16	3.35	-7.06	0.	-0.	-0.	-0.	3.35	-7.06	-0.031	0.
17	9.97	-6.44	0.	-0.	-0.	-0.	9.97	-6.44	-0.031	0.
18	16.59	-5.61	0.	-0.	-0.	-0.	16.59	-5.61	-0.031	0.
19	23.21	-4.60	0.	-0.	-0.	-0.	23.21	-4.60	-0.031	0.
20	26.77	-3.80	0.22	-0.	-0.	-0.	26.52	-4.05	-0.031	0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

CONDITION AF-10

SX	SY	MXX	MYY	T
-1940.	-0.	-146900.	-0.	81200.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
6.65300E 01	4.46348E 02	9.53954E-08	2.56075E 00	-2.18364E-08

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
6.65300E 01	4.46348E 02	9.53954E-08	2.56075E 00	-2.18364E-08

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
0.	-2.93257E 00	8.70626E-01	1.54781E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
2.38282E-06	-0.	-2.97379E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
3.35378E 00	6.15637E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	6.5545
CELL	1	6.5545
WEB	2	-270.7479
CELL	2	277.3024
WEB	3	117.8918
CELL	3	7.7491

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

CONDITION AF-10

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				6.5545
	1	0.	8942.51	8390.51	-17.3799
	2	0.	10156.93	10156.93	-17.3799
	3	0.	12387.04	12387.04	-17.3799
	4	0.	14219.70	14219.70	-17.3799
	5	0.	15588.68	15588.68	-17.3799
WEB	2				253.3681
	6	0.	16008.20	15456.20	159.0653
	7	0.	16184.85	16184.85	159.0653
	8	0.	16008.20	16008.20	159.0653
	9	0.	15412.04	15412.04	159.0653
	10	0.	15014.59	14462.58	125.6409
WEB	3				125.6409
	11	-0.	-15014.59	-14462.58	159.0653
	12	-0.	-15412.04	-15412.04	159.0653
	13	-0.	-16008.20	-16008.20	159.0653
	14	-0.	-16184.85	-16184.85	159.0653
	15	-0.	-16008.20	-15456.20	253.3681
WEB	2				-17.3799
	16	-0.	-15588.68	-15588.68	-17.3799
	17	-0.	-14219.70	-14219.70	-17.3799
	18	-0.	-12387.04	-12387.04	-17.3799
	19	-0.	-10156.93	-10156.93	-17.3799
	20	-0.	-8942.51	-8390.51	6.5545
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

CONDITION LG-4

SX	SY	MXX	MYY	T
-4890.	-0.	-239000.	-0.	-10700.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
6.65300E 01	4.46348E 02	9.53954E-08	2.56075E 00	-2.18364E-08

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
6.65300E 01	4.46348E 02	9.53954E-08	2.56075E 00	-2.18364E-08

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
0.	-2.93257E 00	8.70626E-01	1.54781E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
6.00618E-06	-0.	3.91867E-06

S.C.(X)	S.C.(X/C)	S.C.(Y)
3.35378E 00	6.15637E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	-63.1077
CELL	1	-63.1077
WEB	2	-485.0249
CELL	2	421.9172
WEB	3	26.8362
CELL	3	12.8000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 13.40

22 AUG 63

CONDITION LG-4

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				-63.1077
	1	0.	14549.09	13650.99	-123.4371
	2	0.	16524.89	16524.89	-123.4371
	3	0.	20153.18	20153.18	-123.4371
	4	0.	23134.84	23134.84	-123.4371
	5	0.	25362.11	25362.11	-123.4371
WEB	2				361.5878
	6	0.	26044.66	25146.57	123.8865
	7	0.	26332.05	26332.05	123.8865
	8	0.	26044.66	26044.66	123.8865
	9	0.	25074.72	25074.72	123.8865
	10	0.	24428.09	23530.00	39.6363
WEB	3				39.6363
	11	-0.	-24428.09	-23530.00	123.8865
	12	-0.	-25074.72	-25074.72	123.8865
	13	-0.	-26044.66	-26044.66	123.8865
	14	-0.	-26332.05	-26332.05	123.8865
	15	-0.	-26044.66	-25146.57	361.5878
WEB	2				-123.4371
	16	-0.	-25362.11	-25362.11	-123.4371
	17	-0.	-23134.84	-23134.84	-123.4371
	18	-0.	-20153.18	-20153.18	-123.4371
	19	-0.	-16524.89	-16524.89	-123.4371
	20	-0.	-14549.09	-13650.99	-63.1077
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
61.48	0.6000	1.000	0.	0.

T(TE)	2A(LE)	DS(LE)	T(LE)
0.	273.00	38.300	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-45600.	500.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	24.60	3.70	24.60	-3.70	0.0400
2	0.	6.59	0.	-6.59	0.0400
3	-19.10	5.77	-19.10	-5.77	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	24.85	3.45	0.20	-0.	-0.	-0.	24.60	3.70	0.031	0.
2	21.52	4.17	0.	-0.	-0.	-0.	21.52	4.17	0.031	0.
3	15.36	5.08	0.	-0.	-0.	-0.	15.36	5.08	0.031	0.
4	9.20	5.85	0.	-0.	-0.	-0.	9.20	5.85	0.031	0.
5	3.04	6.41	0.	-0.	-0.	-0.	3.04	6.41	0.031	0.
6	0.	6.34	0.46	-0.	-0.	-0.	0.	6.59	0.031	0.
7	-3.18	6.66	0.	-0.	-0.	-0.	-3.18	6.66	0.031	0.
8	-9.54	6.52	0.	-0.	-0.	-0.	-9.54	6.52	0.031	0.
9	-15.90	6.08	0.	-0.	-0.	-0.	-15.90	6.08	0.031	0.
10	-19.10	5.52	0.17	-0.	-0.	-0.	-19.10	5.77	0.031	0.
11	-19.10	-5.52	0.17	-0.	-0.	-0.	-19.10	-5.77	0.031	0.
12	-15.90	-6.08	0.	-0.	-0.	-0.	-15.90	-6.08	0.031	0.
13	-9.54	-6.52	0.	-0.	-0.	-0.	-9.54	-6.52	0.031	0.
14	-3.18	-6.66	0.	-0.	-0.	-0.	-3.18	-6.66	0.031	0.
15	0.	-6.34	0.46	-0.	-0.	-0.	0.	-6.59	0.031	0.
16	3.04	-6.41	0.	-0.	-0.	-0.	3.04	-6.41	0.031	0.
17	9.20	-5.85	0.	-0.	-0.	-0.	9.20	-5.85	0.031	0.
18	15.36	-5.08	0.	-0.	-0.	-0.	15.36	-5.08	0.031	0.
19	21.52	-4.17	0.	-0.	-0.	-0.	21.52	-4.17	0.031	0.
20	24.85	-3.45	0.20	-0.	-0.	-0.	24.60	-3.70	0.031	0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

CONDITION AF-10

SX	SY	MXX	MYY	T
-1812.	-0.	-111100.	-0.	61600.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
7.88959E 01	5.82907E 02	-7.44628E 00	2.27927E 00	2.61688E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
7.88959E 01	5.82907E 02	-7.44628E 00	2.27927E 00	2.61688E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.36132E 00	2.72265E 00	6.34913E 00	1.28821E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
2.24808E-06	-0.	4.25142E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.79763E 00	5.70761E-01	0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	90.1642
CELL	1	90.1642
WEB	2	-81.0033
CELL	2	171.1675
WEB	3	-7.7434
CELL	3	23.4287

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

CONDITION AF-10

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				90.1642
	1	1.5578	1929.07	1581.10	83.4452
	2	4.6713	2536.25	2536.25	77.1053
	3	6.2174	3708.30	3708.30	65.4508
	4	6.1967	4682.96	4682.96	50.7813
	5	4.6154	5361.55	5361.55	38.4441
WEB	2				119.4475
	6	3.1130	5560.58	5208.11	71.4499
	7	4.7712	5602.00	5602.00	57.9907
	8	6.3684	5290.07	5290.07	40.9584
	9	4.7951	4555.18	4555.18	29.6693
	10	1.6075	4060.48	3708.01	15.6853
WEB	3				15.6853
	11	0.	-12209.59	-11857.12	49.5277
	12	0.	-12589.02	-12589.02	49.5277
	13	0.	-13094.82	-13094.82	49.5277
	14	0.	-13177.66	-13177.66	49.5277
	15	0.	-13021.69	-12669.22	144.9909
WEB	2				63.9876
	16	0.	-12713.16	-12713.16	63.9876
	17	0.	-11812.68	-11812.68	63.9876
	18	0.	-10616.13	-10616.13	63.9876
	19	0.	-9222.19	-9222.19	63.9876
	20	0.	-8504.07	-8147.10	90.1642
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

CONDITION LG-4

SX	SY	MXX	MYY	T
-3900.	-0.	-184500.	-0.	3300.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
7.88959E 01	5.82907E 02	-7.44628E 00	2.27927E 00	2.61688E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
7.88959E 01	5.82907E 02	-7.44628E 00	2.27927E 00	2.61688E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.36132E 00	2.72265E 00	6.34913E 00	1.28821E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
4.83858E-06	-0.	2.27755E-06

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.79763E 00	5.70761E-01	0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	88.9242
CELL	1	88.9242
WEB	2	-161.9219
CELL	2	250.8461
WEB	3	-73.8503
CELL	3	-9.9508

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 27.00

22 AUG 63

CONDITION LG-4

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				88.9242
	1	1.5578	3203.55	2625.69	74.4627
	2	4.6713	4211.86	4211.86	60.8172
	3	6.2174	6158.24	6158.24	35.7330
	4	6.1967	7776.84	7776.84	4.1596
	5	4.6154	8903.75	8903.75	-22.3938
WEB	2				139.5281
	6	3.1130	9234.27	8648.93	36.2222
	7	4.7712	9303.05	9303.05	7.2536
	8	6.3684	8785.04	8785.04	-29.4053
	9	4.7951	7564.63	7564.63	-53.7030
	10	1.6075	6743.10	6157.76	-83.8010
WEB	3				-83.8010
	11	0.	-20276.05	-19690.71	-10.9614
	12	0.	-20906.15	-20906.15	-10.9614
	13	0.	-21746.12	-21746.12	-10.9614
	14	0.	-21883.69	-21883.69	-10.9614
	15	0.	-21624.68	-21039.35	194.5058
WEB	2				32.5838
	16	0.	-21112.32	-21112.32	32.5838
	17	0.	-19616.92	-19616.92	32.5838
	18	0.	-17629.84	-17629.84	32.5838
	19	0.	-15314.98	-15314.98	32.5838
	20	0.	-14122.42	-13529.61	88.9242
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	XO/C	R(WEB)	2A(TE)	DS(TE)
53.64	0.6000	1.000	0.	0.

T(TE)	2A(LE)	DS(LE)	T(LE)
0.	177.00	29.000	0.0200

FP(MAX)	FP(MIN)	FS(MIN)	OP(MAX)
45000.	-30000.	-45600.	500.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	22.74	3.32	22.74	-3.32	0.0400
2	0.	5.92	0.	-5.92	0.0400
3	-17.64	4.98	-17.64	-4.98	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	23.00	3.07	0.20	-0.	-0.	-0.	22.74	3.32	0.031	0.
2	19.90	3.77	0.	-0.	-0.	-0.	19.90	3.77	0.031	0.
3	14.22	4.59	0.	-0.	-0.	-0.	14.22	4.59	0.031	0.
4	8.54	5.27	0.	-0.	-0.	-0.	8.54	5.27	0.031	0.
5	2.86	5.75	0.	-0.	-0.	-0.	2.86	5.75	0.031	0.
6	0.	5.67	0.46	-0.	-0.	-0.	0.	5.92	0.031	0.
7	-2.94	5.98	0.	-0.	-0.	-0.	-2.94	5.98	0.031	0.
8	-8.82	5.85	0.	-0.	-0.	-0.	-8.82	5.85	0.031	0.
9	-14.70	5.35	0.	-0.	-0.	-0.	-14.70	5.35	0.031	0.
10	-17.64	4.73	0.17	-0.	-0.	-0.	-17.64	4.98	0.031	0.
11	-17.64	-4.73	0.17	-0.	-0.	-0.	-17.64	-4.98	0.031	0.
12	-14.70	-5.35	0.	-0.	-0.	-0.	-14.70	-5.35	0.031	0.
13	-8.82	-5.85	0.	-0.	-0.	-0.	-8.82	-5.85	0.031	0.
14	-2.94	-5.98	0.	-0.	-0.	-0.	-2.94	-5.98	0.031	0.
15	0.	-5.67	0.46	-0.	-0.	-0.	0.	-5.92	0.031	0.
16	2.86	-5.75	0.	-0.	-0.	-0.	2.86	-5.75	0.031	0.
17	8.54	-5.27	0.	-0.	-0.	-0.	8.54	-5.27	0.031	0.
18	14.22	-4.59	0.	-0.	-0.	-0.	14.22	-4.59	0.031	0.
19	19.90	-3.77	0.	-0.	-0.	-0.	19.90	-3.77	0.031	0.
20	23.00	-3.07	0.20	-0.	-0.	-0.	22.74	-3.32	0.031	0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

CONDITION AF-10

SX	SY	MXX	MYY	T
-1609.	-0.	-79600.	-0.	45500.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
6.15188E 01	4.84259E 02	-5.10085E 00	2.09606E 00	2.24549E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
6.15188E 01	4.84259E 02	-5.10085E 00	2.09606E 00	2.24549E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.25819E 00	2.51637E 00	5.82229E 00	1.01774E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
2.22612E-06	0.	4.33959E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.45063E 00	5.72956E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	85.8066
CELL	1	85.8066
WEB	2	-80.4876
CELL	2	166.2943
WEB	3	-8.7312
CELL	3	19.8450

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

CONDITION AF-10

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				85.8066
	1	1.4377	1673.15	1352.94	78.7893
	2	4.3072	2217.18	2217.18	72.4624
	3	5.7297	3201.63	3201.63	60.9699
	4	5.7104	4004.78	4004.78	46.6419
	5	4.2826	4548.92	4548.92	34.5956
WEB	2				115.0832
	6	2.9028	4730.07	4406.30	65.3290
	7	4.4110	4767.66	4767.66	52.1996
	8	5.8913	4519.10	4519.10	35.5183
	9	4.4322	3791.37	3791.37	24.7015
	10	1.4816	3272.09	2948.33	11.1138
WEB	3				11.1138
	11	0.	-9626.55	-9302.78	44.0212
	12	0.	-10065.61	-10065.61	44.0212
	13	0.	-10632.92	-10632.92	44.0212
	14	0.	-10721.07	-10721.07	44.0212
	15	0.	-10603.26	-10279.50	140.0180
WEB	2				59.5304
	16	0.	-10344.09	-10344.09	59.5304
	17	0.	-9644.98	-9644.98	59.5304
	18	0.	-8686.87	-8686.87	59.5304
	19	0.	-7547.45	-7547.45	59.5304
	20	0.	-6925.94	-6598.64	85.8066
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

CONDITION LG-4

SX	SY	MXX	MYY	T
-2900.	-0.	-144100.	-0.	15800.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
6.15188E 01	4.84259E 02	-5.10085E 00	2.09606E 00	2.24549E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
6.15188E 01	4.84259E 02	-5.10085E 00	2.09606E 00	2.24549E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.25819E 00	2.51637E 00	5.82229E 00	1.01774E 03

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
4.01228E-06	0.	1.50693E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-1.45063E 00	5.72956E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	87.4871
CELL	1	87.4871
WEB	2	-137.5457
CELL	2	225.0328
WEB	3	-52.4781
CELL	3	-2.1805

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 40.60

22 AUG 63

CONDITION LG-4

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				87.4871
	1	1.4377	3028.91	2449.22	74.8393
	2	4.3072	4013.76	4013.76	63.4359
	3	5.7297	5795.92	5795.92	42.7224
	4	5.7104	7249.86	7249.86	16.8981
	5	4.2826	8234.92	8234.92	-4.8138
WEB	2				132.7319
	6	2.9028	8562.85	7976.74	43.0569
	7	4.4110	8630.91	8630.91	19.3929
	8	5.8913	8180.93	8180.93	-10.6728
	9	4.4322	6863.52	6863.52	-30.1687
	10	1.4816	5923.48	5337.37	-54.6586
WEB	3				-54.6586
	11	0.	-17426.95	-16840.84	4.6525
	12	0.	-18221.78	-18221.78	4.6525
	13	0.	-19248.79	-19248.79	4.6525
	14	0.	-19408.36	-19408.36	4.6525
	15	0.	-19195.09	-18608.99	177.6735
WEB	2				40.1278
	16	0.	-18725.92	-18725.92	40.1278
	17	0.	-17460.33	-17460.33	40.1278
	18	0.	-15725.86	-15725.86	40.1278
	19	0.	-13663.17	-13663.17	40.1278
	20	0.	-12538.05	-11945.52	87.4871
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900
C	**XO/C**	**R(WEB)**	**2A(TE)**	**DS(TE)**
49.16	0.6000	1.000	0.	0.
T(TE)	**2A(LE)**	**DS(LE)**	**T(LE)**	
0.	143.00	27.000	0.0310	
FP(MAX)	**FP(MIN)**	**FS(MIN)**	**QP(MAX)**	
45000.	-30000.	-45600.	500.	

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	20.80	2.97	20.80	-2.97	0.0400
2	0.	5.28	0.	-5.28	0.0400
3	-16.14	4.40	-16.14	-4.40	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	21.05	2.72	0.09	-0.	-0.	-0.	20.80	2.97	0.031	0.
2	18.20	3.35	0.	-0.	-0.	-0.	18.20	3.35	0.031	0.
3	13.00	4.08	0.	-0.	-0.	-0.	13.00	4.08	0.031	0.
4	7.80	4.69	0.	-0.	-0.	-0.	7.80	4.69	0.031	0.
5	2.60	5.13	0.	-0.	-0.	-0.	2.60	5.13	0.031	0.
6	0.	5.03	0.46	-0.	-0.	-0.	0.	5.28	0.031	0.
7	-2.69	5.33	0.	-0.	-0.	-0.	-2.69	5.33	0.031	0.
8	-8.07	5.20	0.	-0.	-0.	-0.	-8.07	5.20	0.031	0.
9	-13.45	4.74	0.	-0.	-0.	-0.	-13.45	4.74	0.031	0.
10	-16.14	4.15	0.17	-0.	-0.	-0.	-16.14	4.40	0.031	0.
11	-16.14	-4.15	0.17	-0.	-0.	-0.	-16.14	-4.40	0.031	0.
12	-13.45	-4.74	0.	-0.	-0.	-0.	-13.45	-4.74	0.031	0.
13	-8.07	-5.20	0.	-0.	-0.	-0.	-8.07	-5.20	0.031	0.
14	-2.69	-5.33	0.	-0.	-0.	-0.	-2.69	-5.33	0.031	0.
15	0.	-5.03	0.46	-0.	-0.	-0.	0.	-5.28	0.031	0.
16	2.60	-5.13	0.	-0.	-0.	-0.	2.60	-5.13	0.031	0.
17	7.80	-4.69	0.	-0.	-0.	-0.	7.80	-4.69	0.031	0.
18	13.00	-4.08	0.	-0.	-0.	-0.	13.00	-4.08	0.031	0.
19	18.20	-3.35	0.	-0.	-0.	-0.	18.20	-3.35	0.031	0.
20	21.05	-2.72	0.09	-0.	-0.	-0.	20.80	-2.97	0.031	0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

CONDITION AF-10

SX	SY	MXX	MYY	T
-1403.	-0.	-53300.	-0.	30900.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
4.50691E 01	3.06472E 02	4.89785E 00	2.93598E-01	2.05533E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
4.50691E 01	3.06472E 02	4.89785E 00	2.93598E-01	2.05533E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.15073E 00	2.30145E 00	5.53005E 00	8.27116E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
4.52632E-06	0.	3.83544E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-2.59914E 00	5.47129E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	68.4846
CELL	1	68.4846
WEB	2	-82.0372
CELL	2	150.5219
WEB	3	-19.2990
CELL	3	21.3640

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

CONDITION AF-10

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				68.4846
	1	1.3138	695.35	394.44	66.6916
	2	3.9393	1194.75	1194.75	62.4597
	3	5.2433	2158.02	2158.02	53.2293
	4	5.2271	2979.14	2979.14	40.5247
	5	3.9115	3598.85	3598.85	29.2638
WEB	2				111.3011
	6	2.6474	3825.78	3529.61	60.1095
	7	4.0360	3935.94	3935.94	47.1309
	8	5.3906	3883.79	3883.79	30.0480
	9	4.0555	3440.69	3440.69	18.4436
	10	1.3557	3088.83	2792.66	2.0650
WEB	3				2.0650
	11	0.	-7336.41	-7040.24	34.4957
	12	0.	-7790.14	-7790.14	34.4957
	13	0.	-8436.95	-8436.95	34.4957
	14	0.	-8692.82	-8692.82	34.4957
	15	0.	-8684.52	-8388.34	136.5071
WEB	2				54.4698
	16	0.	-8556.04	-8556.04	54.4698
	17	0.	-8133.23	-8133.23	54.4698
	18	0.	-7509.02	-7509.02	54.4698
	19	0.	-6742.65	-6742.65	54.4698
	20	0.	-6341.69	-6050.26	68.4846
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

CONDITION LG-4

SX	SY	MXX	MYY	T
-1970.	-0.	-114200.	-0.	26900.

NO. IT.	QXP(N)	QYP(N)
2	-0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
4.50691E 01	3.06472E 02	4.89785E 00	2.93598E-01	2.05533E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
4.50691E 01	3.06472E 02	4.89785E 00	2.93598E-01	2.05533E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.15073E 00	2.30145E 00	5.53005E 00	8.27116E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
6.35556E-06	0.	3.33895E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-2.59914E 00	5.47129E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	76.6235
CELL	1	76.6235
WEB	2	-112.3459
CELL	2	188.9694
WEB	3	-34.1508
CELL	3	14.6668

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 54.20

22 AUG 63

CONDITION LG-4

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				76.6235
	1	1.3138	1489.84	845.12	74.1059
	2	3.9393	2559.86	2559.86	68.1637
	3	5.2433	4623.76	4623.76	55.2029
	4	5.2271	6383.06	6383.06	37.3640
	5	3.9115	7710.85	7710.85	21.5522
WEB	2				133.8981
	6	2.6474	8197.07	7562.49	62.0183
	7	4.0360	8433.10	8433.10	43.7947
	8	5.3906	8321.37	8321.37	19.8080
	9	4.0555	7371.99	7371.99	3.5139
	10	1.3557	6618.09	5983.52	-19.4840
WEB	3				-19.4840
	11	0.	-15718.92	-15084.35	26.0531
	12	0.	-16691.06	-16691.06	26.0531
	13	0.	-18076.92	-18076.92	26.0531
	14	0.	-18625.14	-18625.14	26.0531
	15	0.	-18607.35	-17972.78	169.2907
WEB	2				56.9448
	16	0.	-18332.08	-18332.08	56.9448
	17	0.	-17426.17	-17426.17	56.9448
	18	0.	-16088.74	-16088.74	56.9448
	19	0.	-14446.73	-14446.73	56.9448
	20	0.	-13587.65	-12963.21	76.6235
WEB	1				-0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

SECTION INPUT DATA

WIDTH TOL.	R(STG)	R(PLATE)	W/T	G/1E6
0.050	1.000	1.000	20.00	3.900

C	X0/C	R(WEB)	2A(TE)	DS(TE)
44.30	0.6000	1.000	0.	0.

T(TE)	2A(LE)	DS(LE)	T(LE)
0.	113.00	24.000	0.0310

FP(MAX)	FP(MIN)	FS(MIN)	QP(MAX)
45000.	-30000.	-45600.	500.

WEB	XW(U)	YW(U)	XW(L)	YW(L)	TW
1	18.78	2.57	18.78	-2.57	0.0400
2	0.	4.60	0.	-4.60	0.0400
3	-14.58	3.85	-14.58	-3.85	0.0320

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

SECTION INPUT DATA

ITEM	X(S)	Y(S)	A(S)	IXOS	IYOS	IXYOS	X(P)	Y(P)	T(P)	E/1E6
1	19.00	2.32	0.09	-0.	-0.	-0.	18.78	2.57	0.031	0.
2	16.43	2.95	0.	-0.	-0.	-0.	16.43	2.95	0.031	0.
3	11.73	3.58	0.	-0.	-0.	-0.	11.73	3.58	0.031	0.
4	7.03	4.10	0.	-0.	-0.	-0.	7.03	4.10	0.031	0.
5	2.33	4.48	0.	-0.	-0.	-0.	2.33	4.48	0.031	0.
6	0.	4.35	0.46	-0.	-0.	-0.	0.	4.60	0.031	0.
7	-2.43	4.65	0.	-0.	-0.	-0.	-2.43	4.65	0.031	0.
8	-7.29	4.53	0.	-0.	-0.	-0.	-7.29	4.53	0.031	0.
9	-12.15	4.14	0.	-0.	-0.	-0.	-12.15	4.14	0.031	0.
10	-14.58	3.60	0.17	-0.	-0.	-0.	-14.58	3.85	0.031	0.
11	-14.58	-3.60	0.17	-0.	-0.	-0.	-14.58	-3.85	0.031	0.
12	-12.15	-4.14	0.	-0.	-0.	-0.	-12.15	-4.14	0.031	0.
13	-7.29	-4.53	0.	-0.	-0.	-0.	-7.29	-4.53	0.031	0.
14	-2.43	-4.65	0.	-0.	-0.	-0.	-2.43	-4.65	0.031	0.
15	0.	-4.35	0.46	-0.	-0.	-0.	0.	-4.60	0.031	0.
16	2.33	-4.48	0.	-0.	-0.	-0.	2.33	-4.48	0.031	0.
17	7.03	-4.10	0.	-0.	-0.	-0.	7.03	-4.10	0.031	0.
18	11.73	-3.58	0.	-0.	-0.	-0.	11.73	-3.58	0.031	0.
19	16.43	-2.95	0.	-0.	-0.	-0.	16.43	-2.95	0.031	0.
20	19.00	-2.32	0.09	-0.	-0.	-0.	18.78	-2.57	0.031	0.

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

CONDITION AF-10

SX	SY	MXX	MYY	T
-1222.	-0.	-33600.	-0.	27400.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
3.32853E 01	2.39140E 02	3.91984E 00	1.79449E-01	1.69431E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
3.32853E 01	2.39140E 02	3.91984E 00	1.79449E-01	1.69431E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.03895E 00	2.07790E 00	5.09190E 00	6.52771E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
5.16260E-06	0.	4.90875E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-2.35818E 00	5.46768E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	72.8241
CELL	1	72.8241
WEB	2	-83.5967
CELL	2	156.4208
WEB	3	-18.0381
CELL	3	25.2748

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

CONDITION AF-10

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				72.8241
	1	1.1903	577.31	320.81	70.8806
	2	3.5613	1000.61	1000.61	66.4841
	3	4.7354	1715.71	1715.71	57.3267
	4	4.7220	2319.56	2319.56	44.9799
	5	3.5242	2781.81	2781.81	34.1357
WEB	2				117.7324
	6	2.3818	2941.81	2688.96	64.6480
	7	3.6460	3032.67	3032.67	52.1646
	8	4.8686	2991.87	2991.87	35.7429
	9	3.6614	2677.99	2677.99	24.4940
	10	1.2236	2424.97	2172.12	7.2367
WEB	3				7.2367
	11	0.	-5362.87	-5110.02	39.7598
	12	0.	-5696.46	-5696.46	39.7598
	13	0.	-6171.48	-6171.48	39.7598
	14	0.	-6373.42	-6373.42	39.7598
	15	0.	-6363.14	-6110.29	142.4279
WEB	2				58.8312
	16	0.	-6280.40	-6280.40	58.8312
	17	0.	-5973.98	-5973.98	58.8312
	18	0.	-5525.97	-5525.97	58.8312
	19	0.	-4966.70	-4966.70	58.8312
	20	0.	-4621.32	-4372.12	72.8241
WEB	1				0.0000

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

CONDITION LG-4

SX	SY	MXX	MYY	T
-1053.	-0.	-98900.	-0.	35900.

NO. IT.	QXP(N)	QYP(N)
2	0.00000	-0.

IX(NA)	IY(NA)	IXY(NA)	XBAR	YBAR
3.32853E 01	2.39140E 02	3.91984E 00	1.79449E-01	1.69431E 00

IX(NA)F	IY(NA)F	IXY(NA)F	XBARF	YBARF
3.32853E 01	2.39140E 02	3.91984E 00	1.79449E-01	1.69431E 00

AP(EFF)	AP(FULL)	A(TRUE)	2A(CELLS)
1.03895E 00	2.07790E 00	5.09190E 00	6.52771E 02

THETA X (RADIANS)	THETA Y (RADIANS)	THETA T (RADIANS)
4.44862E-06	0.	6.43154E-05

S.C.(X)	S.C.(X/C)	S.C.(Y)
-2.35818E 00	5.46768E-01	-0.

NET WEB AND INTERNAL CELL SHEAR FLOWS

WEB	1	81.2025
CELL	1	81.2025
WEB	2	-74.6964
CELL	2	155.8989
WEB	3	-8.9993
CELL	3	36.3460

JOB NO. 1012

BOX BEAM ANALYSIS
MODEL XV-5A
VERTICAL TAIL
STATION 67.80

22 AUG 63

CONDITION LG-4

ITEM		WP(EFF)	F(P)	F(S)	QP(NET)
WEB	1				81.2025
	1	1.1903	1699.29	944.30	79.5278
	2	3.5613	2945.24	2945.24	75.7393
	3	4.7354	5050.11	5050.11	67.8484
	4	4.7220	6827.52	6827.52	57.2091
	5	3.5242	8188.14	8188.14	47.8647
WEB	2				122.5611
	6	2.3818	8659.08	7914.82	76.8181
	7	3.6460	8926.51	8926.51	66.0612
	8	4.8686	8806.43	8806.43	51.9106
	9	3.6614	7882.54	7882.54	42.2173
	10	1.2236	7137.78	6393.52	27.3467
WEB	3				27.3467
	11	0.	-15785.35	-15041.09	55.3720
	12	0.	-16767.27	-16767.27	55.3720
	13	0.	-18165.46	-18165.46	55.3720
	14	0.	-18759.87	-18759.87	55.3720
	15	0.	-18729.59	-17985.33	143.8413
WEB	2				69.1448
	16	0.	-18486.05	-18486.05	69.1448
	17	0.	-17584.13	-17584.13	69.1448
	18	0.	-16265.42	-16265.42	69.1448
	19	0.	-14619.24	-14619.24	69.1448
	20	0.	-13602.64	-12869.12	81.2025
WEB	1				0.0000

VERTICAL STABILIZER

SUMMARY OF SPAR CAP MARGINS OF SAFETY

CRITICAL COND: LG-4

STA.	FRONT SPAR			CENTER SPAR			REAR SPAR		
	f_c	F_c	M.S.	f_c	F_c	M.S.	f_c	F_c	M.S.
13.40	23530	42500	+.81	25147	45600	+.82	13651	32400	+1.37
27.00	19691	42500	+1.16	21039	45600	+1.16	13530	35600	+1.63
40.6	16841	42500	+1.52	18609	45600	+1.45	11946	35600	+1.98
54.2	15084	42500	+1.82	17973	45600	+1.54	12963	28800	+1.22
67.80	15041	42500	+1.83	17985	45600	+1.54	12869	28800	+1.24

VERTICAL STABILIZER

SPAR SHEAR ANALYSIS

FRONT SPAR

CRITICAL q = 90 #/IN @ V.S. STA. 27.00, COND. AF-10

.032 7075-T6 WEB

A_s = .053 (.7×.7×.040 ANGLE)

$\frac{A_s}{bt} = \frac{.053}{7 \times .04} = .19$

ALLOW. $q = .76 \times 680 = 516$ #/IN.

(REF. BOEING DESIGN MANUAL, P. 15.62209)

M.S. HIGH

CENTER SPAR

CRITICAL q = 485 #/IN. @ V.S. STA. 13.4, COND. LG-4

.040 7075-T6 WEB

A_s = .114 (.70×.88×.040 & .70×.75×.040 ANGLES)

$\frac{A_s}{bt} = \frac{.114}{6.9 \times .04} = .41$

ALLOW. $q = .94 \times 920 = 864$ #/IN.

$M.S. = \frac{864}{485} - 1 = +.78$

VERTICAL STABILIZER

REAR SPAR

CRITICAL $q = 118$ #/IN @ V.S.STA. 13.4, COND. AF-10

.040 7075-T6 WEB

$A_s = .055$ (.70 × .75 × .04 ANGLE)

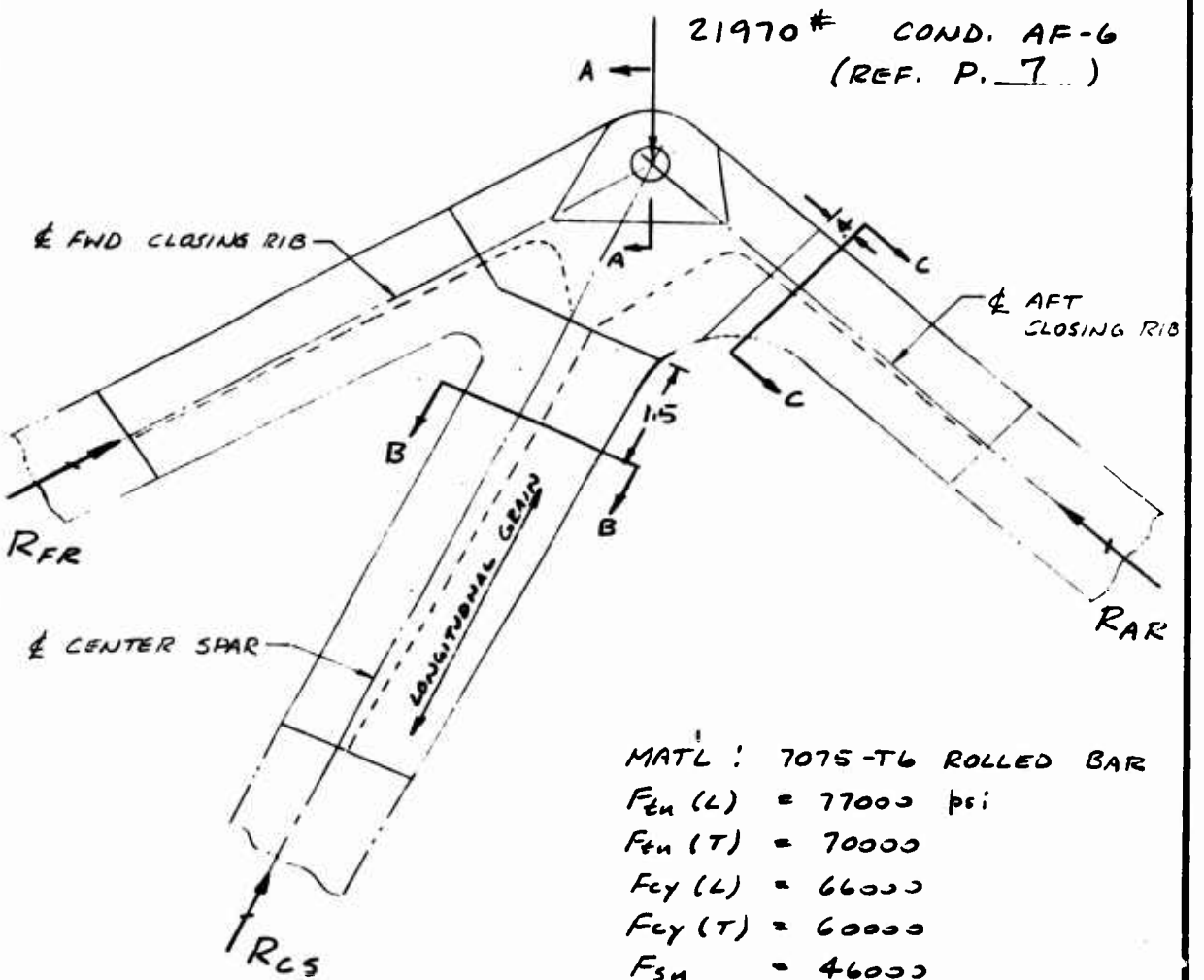
$\frac{A_s}{bt} = \frac{.055}{6.8 \times .04} = .2$

ALLOW. $q = .76 \times 920 = 699$ #/IN.

M.S. HIGH

SUBJECT: SECTION: ENGINEER: CHECKER:	VERTICAL STABILIZER	MODEL: PAGE: REPORT: DATE:

PIVOT FITTING (DWG. 143T008)



MATL: 7075-T6 ROLLED BAR

F_{tu} (L) = 77000 psi
F_{tu} (T) = 70000
F_{cy} (L) = 66000
F_{cy} (T) = 60000
F_{su} = 46000
F_{bru} = 125000 (e/D = 2)

VERTICAL STABILIZER

PIVOT FITTING (DWG. 143T008)

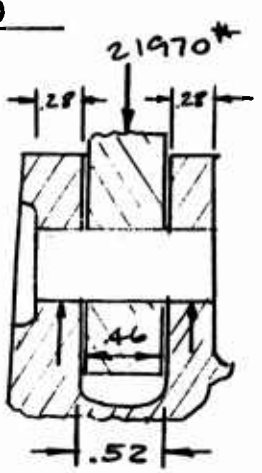
THE DISTRIBUTION OF PIVOT LOAD TO THE FWD & AFT RIB FLANGES AND CENTER SPAR IS REDUNDANT. THE FOLLOWING DISTRIBUTION WAS DETERMINED BY A REDUNDANT ANALYSIS OF THE STRUCTURE ABOVE V.S. STA. 72.05:

$R_{FR} = 1530$ #

$R_{CS} = 15200$ #

$R_{AR} = 10490$ #

PIN



NAS 1138 SCREW (1/2" DIA.)

ALLOW. DBL SHEAR = 37300 #

$$M.S. = \frac{37300}{21970} - 1 = +.70$$

$$B.M. = \left(\frac{.28}{2} + \frac{.46}{4} + .03\right)\frac{21970}{2}$$

$$= 3130 \text{ "#}$$

$$f_b = \frac{3130 \times .25}{.003069} = 255000 \text{ psi}$$

$$F_b = 1.7\, F_{tu} = 1.7 \times 160000$$

$$= 272000 \text{ psi}$$

$$M.S. = \frac{272000}{255000} - 1 = +.07$$

$$f_{br} = \frac{21970}{2 \times .28 \times .5} = 79000 \text{ psi}$$

$$M.S. = \frac{123000}{79000} - 1 = +.56$$

VERTICAL STABILIZER

PIVOT FITTING

CENTER SPAR LEG

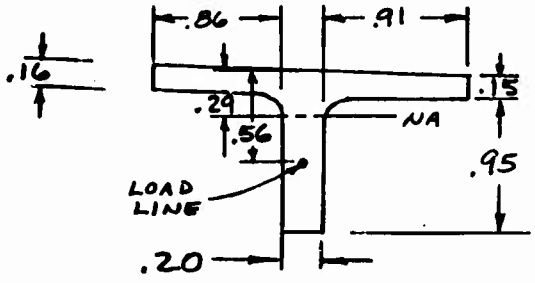
ATTACHMENT TO SPAR CAP:

18 BC 5 IN DBL SHEAR & 9 CX 6 IN DBL SHEAR

TOTAL ALLOW. LOAD = $2(18 \times 556 + 9 \times 1180) = 41200$#

$$M.S. = \frac{41200}{15200} - 1 = +1.71$$

SECT. B-B:



$A = .509$ $I = .0701$

LOAD IS TRANSFERED TO SPAR BY 4 BC5 & 2 CX6

$P_{B-B} = \frac{7}{9} \times 15200 = 11800$#

B.M. $= 11800\ (.56 - .29) = 3190$"#

$$f_c = -\frac{11800}{.509} - \frac{3190 \times .81}{.0701}$$

$= -23200 - 36800 = -60000$ psi

$F_{cy} = 66000$ psi

$$M.S. = \frac{66000}{60000} - 1 = +.10$$

VERTICAL STABILIZER

PIVOT FITTING

AFT CLOSING RIB LEG

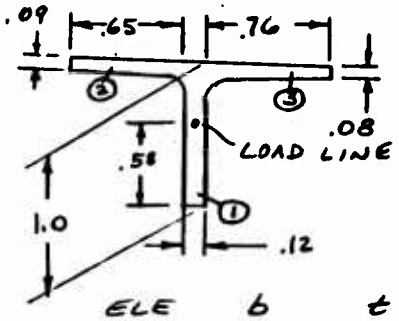
ATTACHMENT TO RIB FLANGE: (REF. DWG 143T010)

4 BB 5, 5 BC 5 & 5 BJ 5 ALL IN DBL SHEAR

TOTAL ALLOW. LOAD = $2(5 \times 556 + 9 \times 596) = 16280$ #

$$M.S. = \frac{16280}{10490} - 1 = +.55$$

SECT. C-C:



$A = .243$ $\quad \bar{y} = .269$

FIND CRIPPLING ALLOWABLE BY CONVAIR METHOD (REF. CONVAIR STRUCTURES MANUAL P. 2.241 & STRESS MEMO # 20). ASSUME F_{cy} = 60000 psi, TRANVERSE VALUE

ELE	b	t	b/t	$\frac{1}{\sqrt{k}}$	$\frac{b}{t\sqrt{k}}$	A	F_{cn}	P_{cn}
1	.91	.12	7.57	1	7.57	.109	69000	7520
2	.65	.09	7.2	1.25	9	.0585	60000	3510
3	.76	.085	8.95	1.25	11.2	.0646	52000	3360
Σ						.2321		14390

$$F_{cr} = \frac{\Sigma P_{cn}}{\Sigma A} = \frac{14390}{.2321} = 62000 \text{ psi}$$

FIND ALLOWABLE PLASTIC BENDING MOMENT ASSUMING SKIN LEGS 2 & 3 ARE IN TENSION.

LOAD IN ELE ① = $69000 \times .91 \times .12 = 7520$ #

AREA OF SKIN LEGS = $.243 - .91 \times .12 = .134$

VERTICAL STABILIZER

PIVOT FITTING

SECT. C-C (CONT.) :

TENSION STRESS = $7520/.134 = 56000$ psi O.K.

ALLOW. B.M. = $7520\left(\frac{.91}{2} + \frac{.09}{2}\right) = 3760$ "#

LOAD @ SECT. C-C IS RELIEVED BY 3 RIVETS

ALLOW = $2(556 + 2\times596) = 3300$ #

LOAD @ SECT. C-C = $\frac{16280 - 3300}{16280} \times 10490 = 8350$ #

B.M. = $8350\ (.731 - .58) = 1260$ "#

$f_c = \frac{8350}{.243} = 34400$ psi

$R_c = \frac{34400}{62000} = .555$

$R_{BM} = \frac{1260}{3760} = .335$

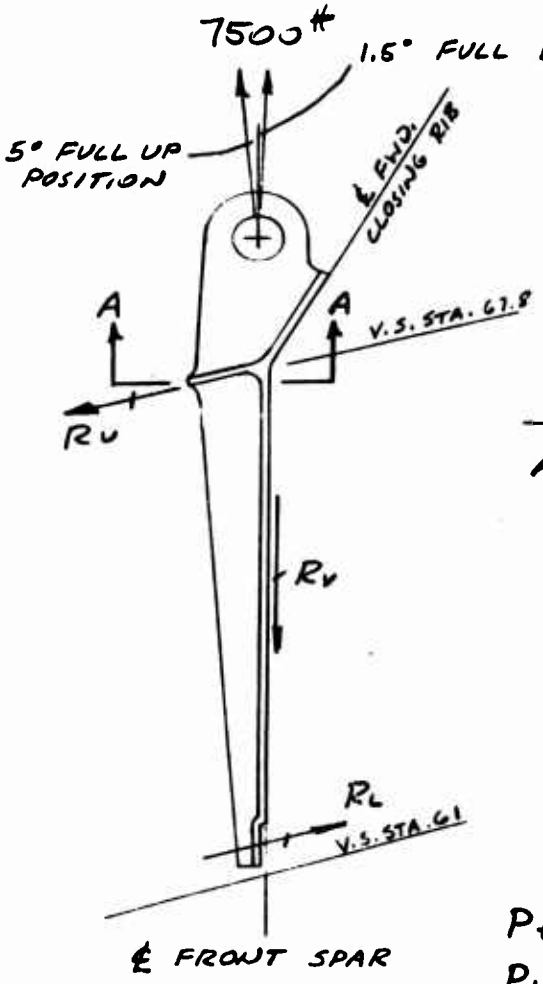
$R_c + R_{BM} = 1$

$$M.S. = \frac{1}{.555 + .335} - 1 = \underline{\underline{+.12}}$$

SUBJECT: SECTION: ENGINEER: CHECKER:	VERTICAL STABILIZER	MODEL: PAGE: REPORT: DATE:

HORIZ. STAB. ACTUATOR SUPPORT FITTING (DWG. 143T006)

(REF. PG. 7 FOR LOAD)



MAT'L : 7075 - T6
ROLLED BAR

F_{tu} (L) = 77000 psi
F_{tu} (T) = 70000 psi

LUG

ANALYZED BY MELCON-HOBLIT METHOD

$a = .65 \quad D = .6875 \quad t = .32$

$W/D = 1.3/.6875 = 1.89$

$a/D = .65/.6875 = .945$

$D/t = .6875/.32 = 2.15$

$A_t = (1.3 - .6875).32 = .196$

$A_{br} = .6875 \times .32 = .22$

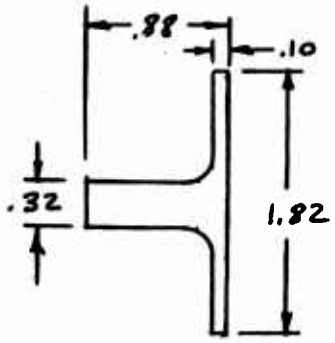
$P_{tu} = .97 \times .196 \times 77000 = 14600\#$

$P_{bru} = .78 \times .22 \times 70000 = 12000\#$

$$M.S. = \frac{12000}{7500} - 1 = +.60$$

HORIZ. STAB. ACTUATOR SPT. FTG.

SECT. A-A



$A = .432$

$I = .0331$

$\bar{x} = .304$

ECCENTRICITY $= .304$

$B.M. = 7500 \times .304 = 2280$ "#

$$f_t = \frac{7500}{.432} + \frac{2280 \times .304}{.0331}$$

$$= 17400 + 20900 = 38300 \text{ psi}$$

$F_t = .75\, F_{tu} = .75 \times 77000 = 57700$ psi (ALLOWABLE STRESS FOR GROSS AREA)

$$M.S. = \frac{57700}{38300} - 1 = +.51$$

ATTACHMENT TO FRONT SPAR

4 CX 6 AND 14 BJ 5 RIVETS BEARING ON .032 WEB

ALLOWABLE $= 4 \times 146000 \times .032 \times .188 + 14 \times 596 \times .932 = 11300$ #

$$M.S. = \frac{11300}{7500} - 1 = +.51$$

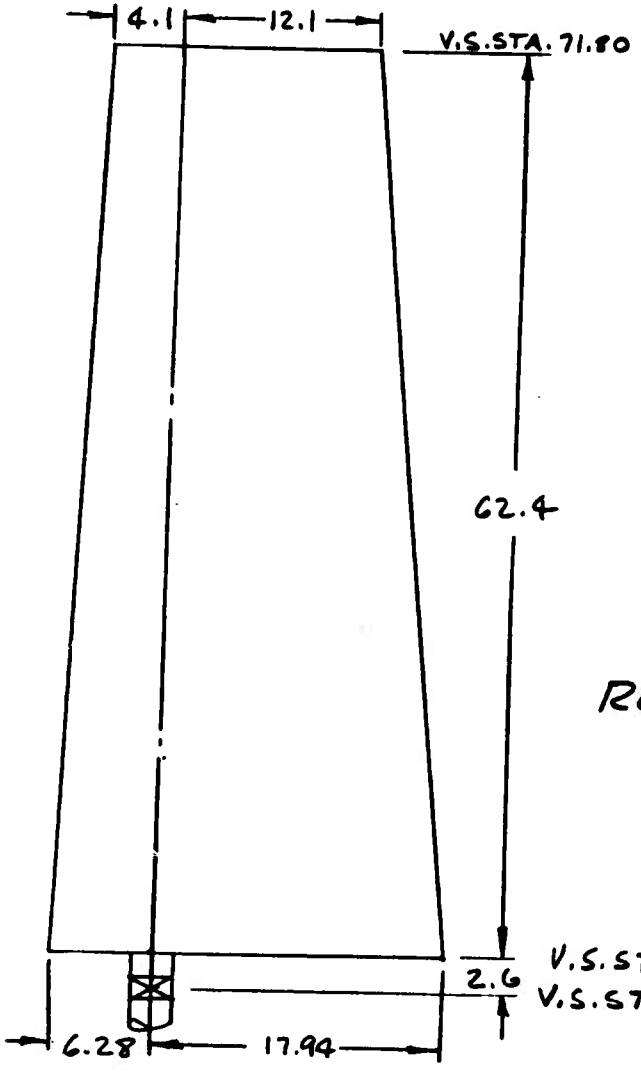
V. RUDDER

LOADING

MAX. LOADING OCCURS IN COND. AF-9 OR AF-10, WHICH ARE ABRUPT RUDDER DEFLECTION CONDITIONS AT MACH NO. .397 AND q = 234 psf.

TOTAL ULT. LOAD = 1935 #

ULT. RUDDER HINGE MOMENT = 3330 "#



AREA = 1260 IN^2

Av. $p = \frac{1935}{1260} = 1.533$ psi

LOADING @ UPR. END, W_u =

$1.533 \times 16.2 = 24.85$ #/IN.

LOADING @ LWR. END, W_L =

$1.533 \times 24.22 = 37.2$ #/IN.

REF. DWG. 143 T050

RUDDER

HINGE LOADS

C.P. IS 28.15" ABOVE LOWER EDGE

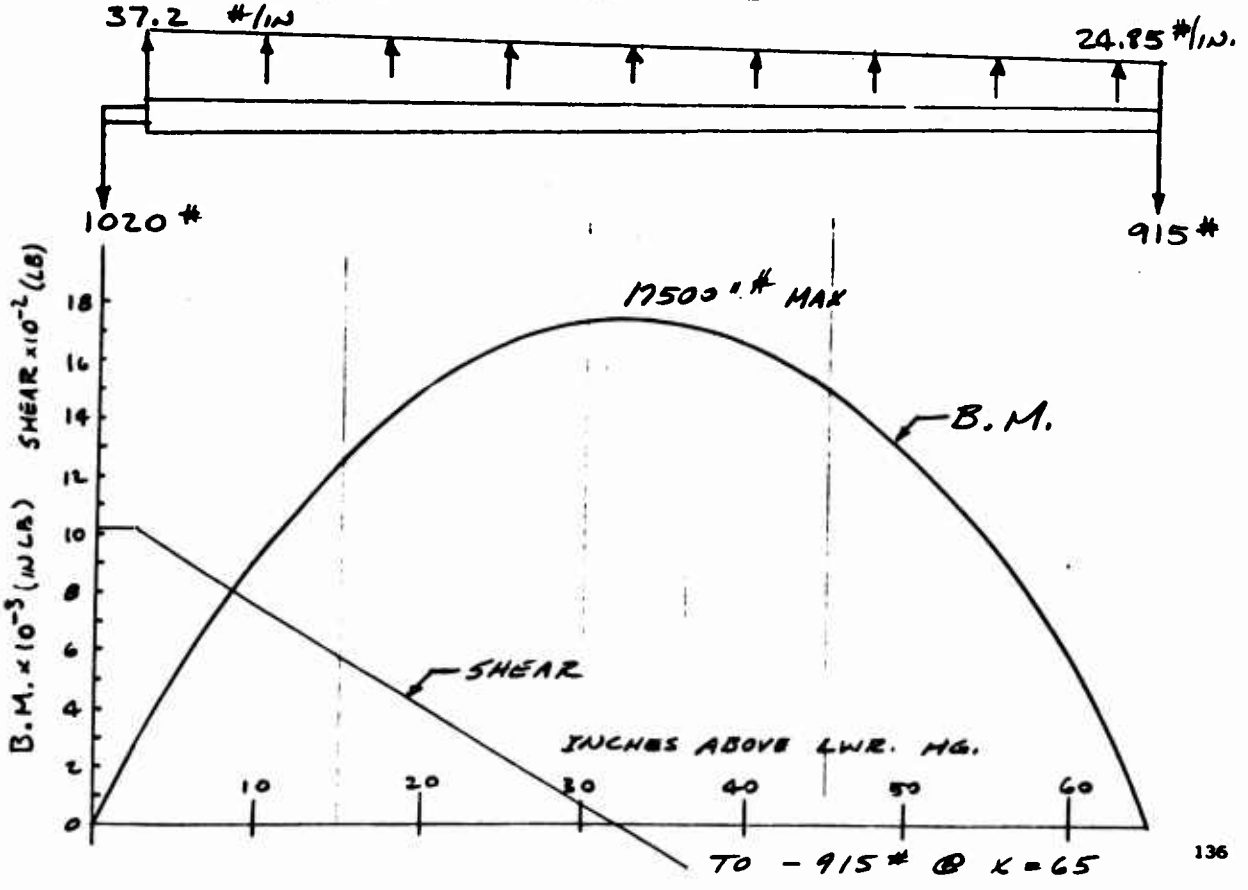
$R_U = \frac{30.75 \times 1935}{65} = 915\ \#$

$R_L = 1935 - 915 = 1020\ \#$

CABLE LOAD APPLIED TO TENSION REGULATOR = HINGE MOMENT/RADIUS = 3330/5.5 = 605 #

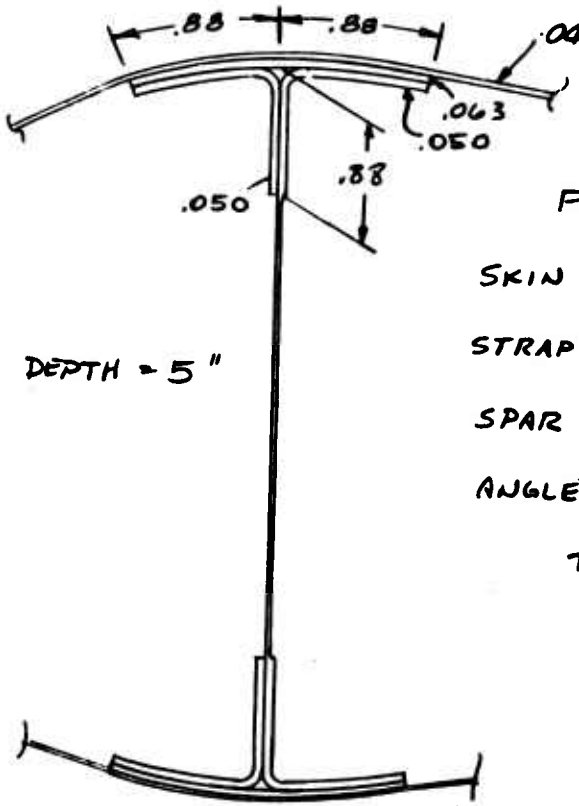
THIS LOAD IS ASSUMED TO BE REACTED AT LOWER HINGE FITTING.

SHEAR & BENDING MOMENT



RUDDER

BENDING ANALYSIS — MAX. B.M. @ V.S. STA. 39.3



FLANGE AREA :

SKIN	$2 \times .040 \times \frac{6.5}{10.5}$	= .0495
STRAP	$1.76 \times .063$	= .1110
SPAR	$2 \times .83 \times .050$	= .083
ANGLE	$2 \times .83 \times .050$	= .083
TOTAL A		= .3265

FLANGE LOAD = $M/h = \frac{17500}{4.4} = 3980$ #

$f_c = 3980/.3265 = 12200$ psi

M.S. AMPLE *

* LARGE MARGIN OF SAFETY RESULTS FROM DESIGN BEING BASED ON STIFFNESS REQUIREMENT TO PREVENT FLUTTER.

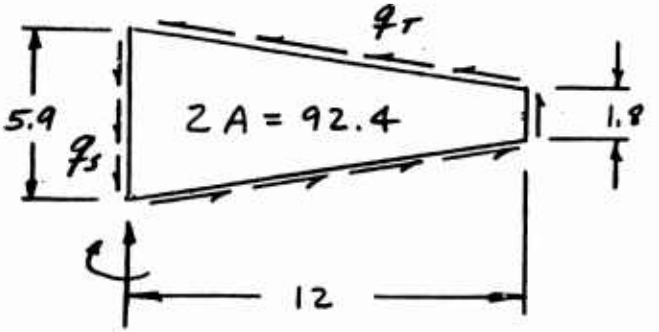
RUDDER

SHEAR ANALYSIS

CRITICAL SECTION @ LOWER END.

NEGLECT NOSE BOX.

$T = 3330$ "# $S = 1020$ #



$q_T = 3330/92.4 = 36$ #/IN.

$q_S = \frac{1020}{5.3} + 36 = 228$ #/IN.

.020 MAG SKIN

$f_S = 36/.02 = 1800$ psi

M.S. AMPLE

.032 7075-T6 SPAR WEB

$f_S = 228/.032 = 7120$ psi

M.S. AMPLE